INSTRUCTION MANUAL

TYPE RM561A OSCILLOSCOPE

MANUFACTURERS OF CATHODE-RAY OSCILLOSCOPES

INSTRUCTION MANUAL

Serial Number _____

TYPE RM561A OSCILLOSCOPE

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WARRANTY

All Tektronix instruments are warranted against defective materials and workmanship for one year. Tektronix transformers, manufactured in our own plant, are warranted for the life of the instrument.

Any questions with respect to the warranty mentioned above should be taken up with your Tektronix Field Engineer.

Tektronix repair and replacement-part service is geared directly to the field, therefore all requests for repairs and replacement parts should be directed to the Tektronix Field Office or Representative in your area. This procedure will assure you the fastest possible service. Please include the instrument Type and Serial number with all requests for parts or service.

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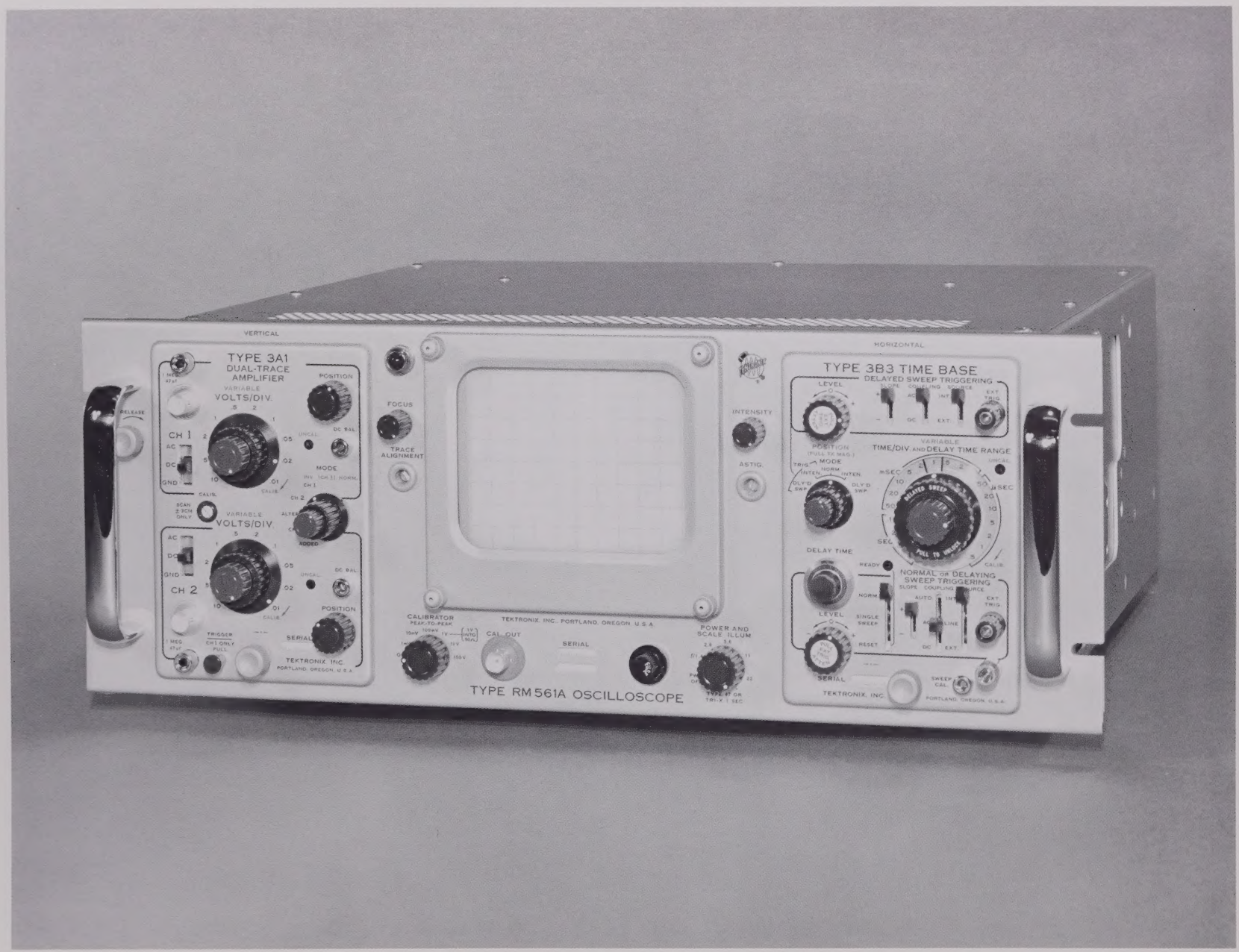

VERTICAL
TYPE 3A1
DUAL-TRACE
AMPLIFIER
VARIABLE
VOLTS/DIV.
POSITION
CH 1
CH 2
MODE
DC BAL
TRIGGER
SERIAL
TEKTRONIX INC
PORTLAND, OREGON, U.S.A.
FOCUS
TRACE
ALIGNMENT
INTENSITY
ASTIG.
TEKTRONIX, INC., PORTLAND, OREGON, U.S.A.
CALIBRATOR
PEAK-TO-PEAK
CAL OUT
SERIAL
POWER AND
SCALE ILLUM
TYPE RM561A OSCILLOSCOPE
HORIZONTAL
TYPE 3B3 TIME BASE
DELAYED SWEEP TRIGGERING
LEVEL
SLOPE
COUPLING
SOURCE
EXT TRIG
TIME/DIV. AND DELAY TIME RANGE
DELAYED SWEEP
PULL TO UNCAL
DELAY TIME
READY
NORMAL OR DELAYING
SWEEP TRIGGERING
SINGLE
SWEEP
RESET
SWEEP
CAL.
TEKTRONIX, INC.
PORTLAND, OREGON, U.S.A.

SECTION 1

CHARACTERISTICS

General Information

The Tektronix Type RM561A Oscilloscope is essentially an indicator unit with provision for two plug-in units. The plug-in unit in the right-hand opening controls the horizontal (X-axis) deflection, and the plug-in unit in the left-hand opening controls the vertical (Y-axis) deflection. The plug-in units can be selected from any of the Tektronix '2' Series or '3' Series groups to provide the desired oscilloscope performance.

Cathode-Ray Tube

Type—T5610-31-1 (rectangular ceramic-envelope).

Phosphor—P31.

Unblanking—Deflection type, dc-coupled, with grid intensification.

Graticule—Variable edge lighted "no parallax" internal graticule. Marked in 8 vertical and 10 horizontal divisions with each major division divided into 5 minor divisions on centerlines.

Accelerating voltage—3.5 kv.

Useable viewing area—8 divisions vertical by 10 divisions horizontal.

Deflection factors—18.5 to 20.5 volts per centimeter vertical, and 17.5 to 19.3 volts per centimeter horizontal.

Calibrator

Waveform—Square waves at the line frequency.

Output voltage—1 millivolt to 100 volts, peak-to-peak, in 6 steps. One output is 0.1 volt into 50 ohms.

Accuracy—Peak-to-peak amplitude within 3% of indicated voltage.

Risetime—Typically 4 microseconds.

Power Supplies

Electronically regulated for stable operation with normal line voltage variations and widely varying loads. The low voltage supplies hold regulation within ±1% of value.

Line voltage requirements—105 to 125 volts, or 210 to 250 volts, rms, 50 to 60 cps, single-phase ac.

Fuse requirements—3-amp slow-blowing type for 117 volts, 1.25-amp slow-blowing type for 234 volts.

Ventilation

Forced air cooled. Thermal cutout interrupts instrument power in the event it overheats.

Construction

Aluminum-alloy chassis.

Photo-etched anodized front panel.

Weight—30½ pounds, indicator unit only.

Dimensions—see Fig. 2-1.

NOTES

SECTION 2

INSTALLATION

Cooling

A fan at the rear of the RM561A is used for cooling. The entire fan assembly is in a snap-in mounting that can be mounted in one of two ways to select the direction of air flow. Air can be drawn from the front of the instrument and exhausted out the rear, or air may enter from the rear and blow toward the front. Selection of air flow direction depends on whether the air at the front or the rear of the instrumment is most desireabe for cooling

Adequate instrument cooling is important because vacuum tubes should not operate with envelope temperatures above 150° C (302° F) when the ambient temperature is at 25° C (77° F), or above 175° C (347° F) when the ambient temperature is at 50° C (122° F). The Type RM561A can operate in ambient temperature up to 50° C. If the instrument overheats, the thermal cutout will turn off the power; then when the temperature drops to a safe value power is restored. If wired for 117-volt operation, the fan will continue to operate if the thermal cutout opens. This is not true for 234-volt operation.

Line Voltage

The Type RM561A instrument can be wired for either 117-volt or 234-volt operation. It will operate properly between 105 and 125 volts when wired for 117-volt operation, and between 210 and 250 volts when wired for 234-volt operation.

Converting from one operating voltage to another requires a change in the power transformer primary connections, fan connections, the fuse, and the male line cord plug.

The Power Supply schematic indicates the transformer primary and fan connections for 117-volt and 234-volt operation. A 3-amp slow-blowing type fuse is required for 117-volt operation, and a 1.25-amp slow-blowing type fuse is required for 234-volt operation.

RACKMOUNTING INSTRUCTIONS

The Type RM561A Oscilloscope may be mounted in a standard 19" open or closed rack either directly or by using slideout tracks.

When the instrument is mounted directly to the rack, it is attached to the rack front rails with four screws. The rear of the instrument needs no support when mounted in this manner.

If the slideout tracks are used, the instrument will slide out of the rack like a drawer. The instrument is locked into the rack with the two RELEASE knobs on the front panel. When fully extended from the rack, the instrument may be tilted and locked in one of seven positions; horizontal, or 45°, 90°, and 105° above and below the horizontal.

Mounting Dimensions

Instrument Dimensions and Weight

Fig. 2-1 shows Type RM561A dimensions exclusive of the plug-in units, power cord, and probes. The instrument weighs 30½ pounds without plug-in units. The weight is increased by about 8⅝ pounds when slideout tracks are used.

Rack Dimensions

Width—A standard 19" rack may be used. (Allow 5/16" minimum on each side of the instrument when slideout tracks are used.)

Depth—For circulation of cooling air, allow 3" behind the rear of the Type RM561A and any rear enclosure on the rack. This 3" also leaves room for the power cord. The space allowed can be reduced to 2" when special cooling arrangements are made and a power cord with right-angle female connector is used.

Direct Rackmounting

The RM561A front panel has four notches (two on each side) for fastening the instrument directly to the rack. The notches are 1½" from the top and bottom of the front panel with 4" between them.

Installation Procedure

1. From the hardware kit supplied with the instrument, select four screws with threads that match those of the rack front rails.

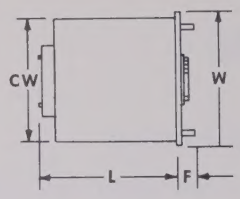
2. Place the cup washer, then the plastic washer, on the proper screws and fasten the Type RM561A to the rack. (The plastic washers keep the cup washers from marring the instrument front panel.)

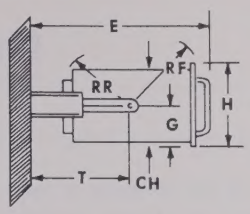
Slideout Rackmounting

Slideout Track Information

The slideout tracks used for the Type RM561A consists of two assemblies, one each for the right and left sides. Each assembly consists of three sections, as shown in Fig. 2-2. The stationary section attaches to the rack, the chassis section attaches to the instrument, and the intermediate section fits between the other two sections to allow the instrument to extend out of the rack.

If your instrument was ordered with slideout tracks, (Mod 171; optional equipment at slight additional cost) the tracks and necessary hardware were shipped with the instrument and the chassis sections are attached. In this case use steps 2 and 3 of the following "Chassis Section Installation" procedure, to check the alignment of the chassis sections.





Symbol	Description	Definition	Dimension
H	Height	Height of front panel.	7 inches
W	Width	Width of front panel.	19 inches
L	Length	Rack front mounting surface to rearmost permanent fixture, excluding cables.	$18\frac{3}{8}$ inches
F	Forward Clearance	Rack front mounting surface to foremost protrusion.	$1^{11}/_{16}$ inches
CW	Cabinet Width	Cabinet Width	$16\frac{7}{8}$ inches
G	Vertical Axis	Bottom of front panel to axis of rotation.	$2\frac{5}{16}$ inches
E	Extended Inst.	Maximum forward clearance with instrument out and horizontal.	$24\frac{5}{16}$ inches
RF	Radius—front	Axis of rotation to formost protrusion.	$13\frac{7}{16}$ inches
RR	Radius—rear	Axis of rotation to rearmost protrusion.	$7\frac{1}{8}$ inches
T	Track	Fully extended chassis track axis of rotation.	$11\frac{1}{8}$ inches
CH	Cabinet Height	Cabinet height.	$6^{27}/_{32}$ inches

Fig. 2-1. RM561A rackmounting dimensions.

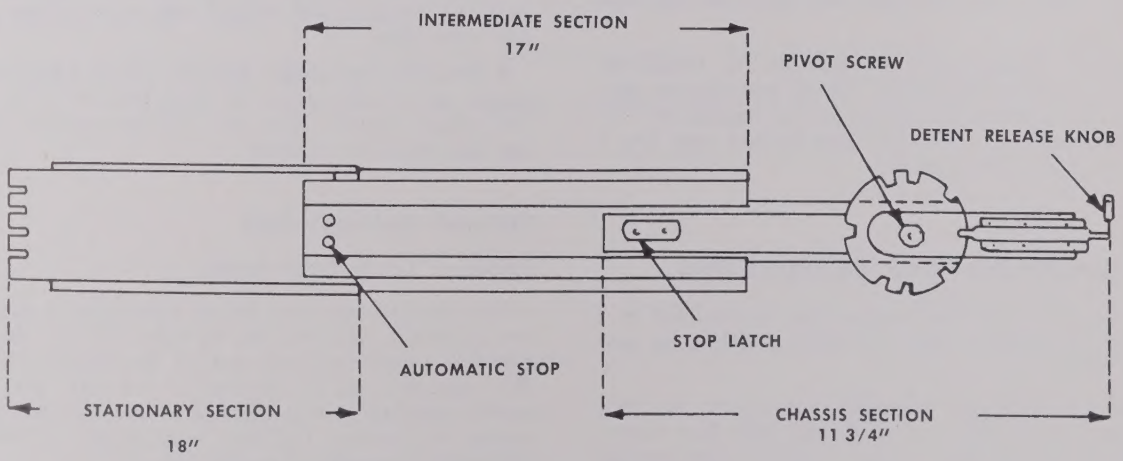


Fig. 2-2 Slideout track assembly.

If your instrument was ordered without specifying Mod 171, the slideout track assemblies with hardware may be ordered separately from your local Tektronix Field Office.

For complete installation hardware, order the following item:

1 guide slide assembly—Tektronix Part No. 351-050.

To order only part of the hardware, order desired items of the following:

(1) 1 slide—Tektronix Part No. 351-027

(2) 1 guide cabinet lt—Tektronix Part No. 351-010

(3) 1 guide cabinet rt—Tektronix Part No. 351-011

Tektronix part number 351-027 includes right and left chassis sections. Part number 351-010 includes one stationary section with its matched intermediate section for the left side and part number 351-011 is the matched sections for the right side.

Chassis Section Installation

Use the following procedure to mount a chassis section of the track to each side of the Type RM561A. See Fig. 2-3 for installation details.

1. Remove the pivot screw with its flat washer, lock washer, and nut.

2. With the six pan screws, lock washers, and nuts provided, mount the detent bar assembly to the instrument chassis through the six prepunched chassis holes. Make sure the detent bar assembly is parallel to the bottom of the chassis and that the pivot screw holes line up when the screws are tightened.

3. Mount the outer slide, using the pivot screw and hardware removed in step 1. Turn the pivot screw until the outer slide is parallel to the bottom of the chassis. Hold the screw in this position and tighten the nut.

4. Make sure the detent release knob is screwed tightly into the detent bar.

Stationary and Intermediate Sections Installation

The stationary and intermediate sections for both sides of the rack are shipped as a matched set and should not be separated. Use the following installation procedure for both sets. The matched sets can be installed on either side of the rack. See Fig. 2-4 for installation details.

1. Mark a point on the rack front rail $3\frac{3}{4}$ inches down from where the top edge of the RM561A front panel will be. This point is where the top notch of the mounting flange will be centered.

2. Locate or drill two holes (large enough for 10-32 screws) in the front rail of the rack, one at the point located in step 1 and, if possible, the other at a point matching a notch nearest the bottom edge of the mounting flange.

3. Insert one screw through each of the two holes located or drilled in step 2. If the back of front panel must fit flush against the rack rail, countersink the holes and use flat head screws—otherwise use pan head screws without countersinking. Loosely attach a bar nut to the screws. (Existing holes in the rail may have to be enlarged so the screws turn freely into the bar nuts.)

4. Insert the stationary section mounting flange under the bar nut attached in step 3 so both screws are in the correct notches. Tighten the screws so the stationary section is held firmly against the front rail.

5. Compare the depth of the rack to the slideout track length to determine whether the rear mounting bracket should be mounted in the normal position or reverse position as shown in Fig. 2-4.

6. Hold the stationary section perpendicular to the front rail and determine which holes in the rear of the rack will be used for mounting. If there are no holes, drill two $\frac{13}{64}$" holes that match the notches in the rear mounting bracket.

7. Attach the rear mounting bracket to the rear of the rack and then to the stationary section using bar nuts, screws, and spacers as indicated in Fig. 2-4.

Instrument Insertion

1. After mounting both stationary sections, pull out the intermediate sections to their fully extended position. Be sure the automatic stops hold the intermediate sections in this position. (The stops will automatically release when the instrument is slid into place.)

2. Insert the Type RM561A into the rack by sliding the chassis sections into the intermediate sections. Depress the stop latches on both chassis sections (see Fig. 2-2) and carefully push the instrument into the rack. Loosen the screws holding stationary sections to the rack if instrument binds when it is inserted.

NOTE

Check the stability of the rack. If the rack is unstable with the instrument in the fully-extended position, add a counter-weight at the bottom rear of the rack or bolt the rack to the floor.

Slideout Track Adjustment

1. To adjust the slideout tracks for smooth operation, pull the Type RM561A out until the pivot screws are even with the rack front rails.

2. Loosen the screws holding both stationary sections to the front rails and allow the tracks to adjust to the instrument and the rack.

3. Tighten the screws and push the instrument back into the rack.

4. Loosen the screws holding the rear brackets to the rack, and again allow the tracks to adjust to the instrument and the rack. Tighten the screws.

5. If necessary, loosen the nut on the pivot screws and adjust the outer slides so the instrument moves smoothly in the tracks with the top and bottom corners of the front panel flat against the rack front rails when closed.

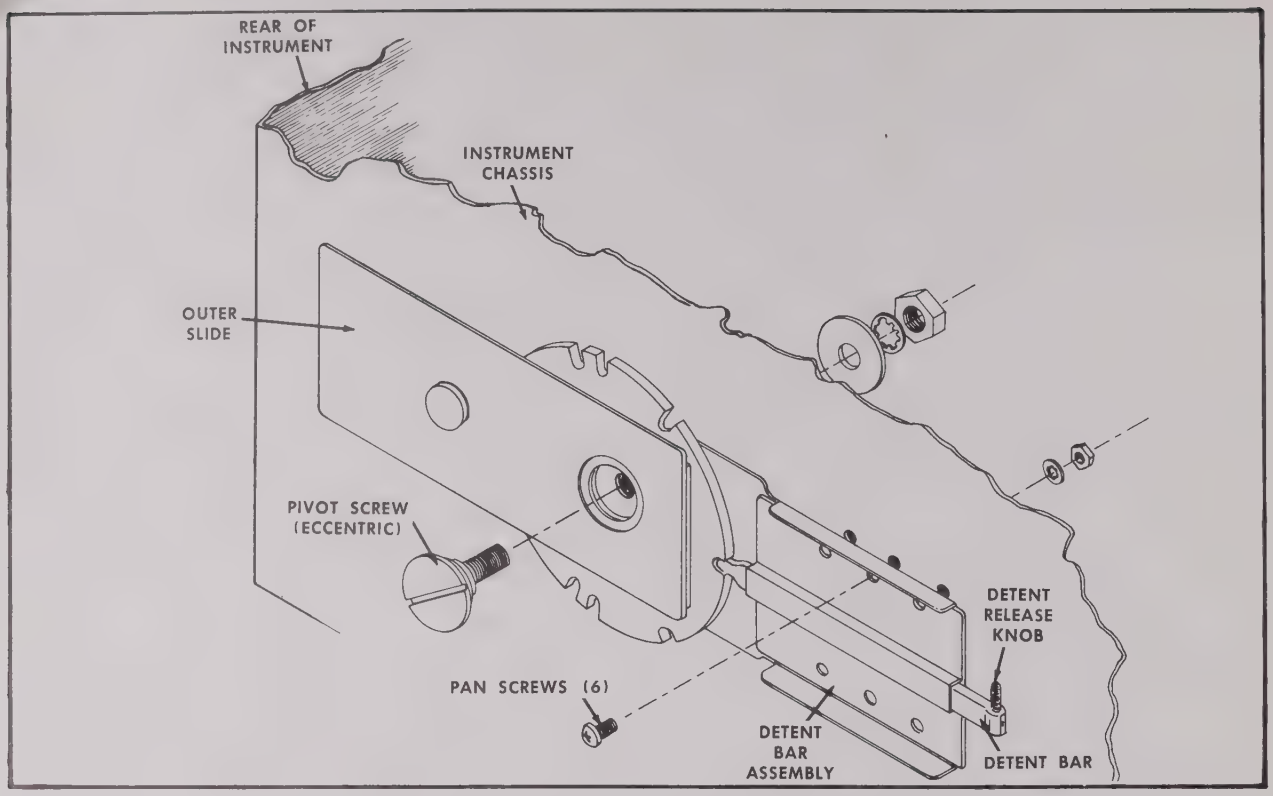


Fig. 2-3. Details for mounting chassis section to instrument.

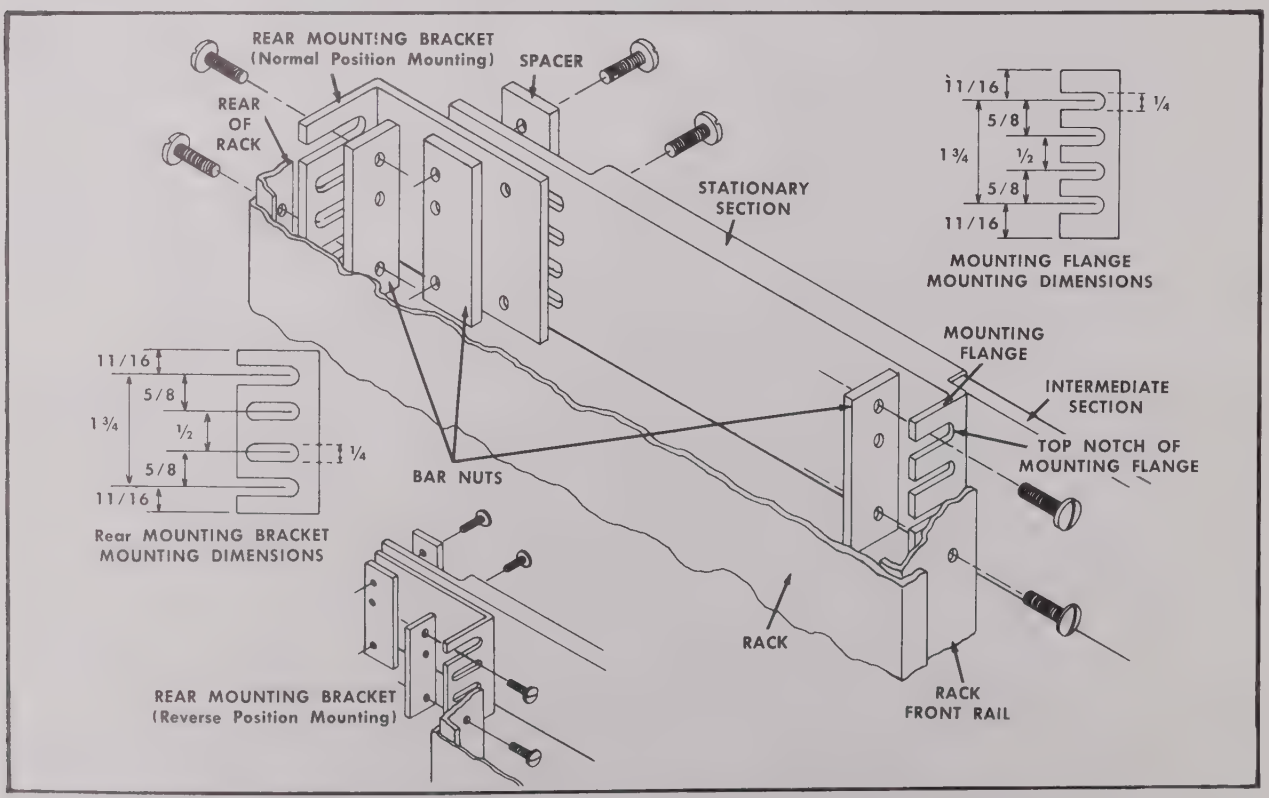


Fig. 2-4. Details for mounting stationary section (with its intermediate section) to Rack.

SECTION 3

OPERATING INFORMATION

Introduction

The Tektronix Type RM561A Oscilloscope, with two plug-in units inserted, operates the same way as any oscilloscope with corresponding vertical and horizontal deflection systems. The plug-in units take the place of the deflection systems and their outputs are connected directly to the cathode-ray tube deflection plates. The plug-in units can be selected to give the type of performance desired of the Type RM561A.

Changing Plug-In Units

Before inserting a plug-in unit into the Type RM561A Oscilloscope, make sure the latching bar (bottom front) is not pointing down. Then push the plug-in unit all the way into the opening. Turn the aluminum knob, at the bottom center of the unit, clockwise until it is tight. To remove the unit, turn the knob counterclockwise several turns and pull.

Different plug-in units apply slightly different dc voltages to the crt deflection plates. The Type RM561A crt has higher horizontal deflection sensitivity than vertical deflection sensitivity. Also, changing one plug-in unit can affect the accuracy of the other unit installed. Therefore, if one or both of the units are replaced, check the gain of both units. If a plug-in needs adjustment, follow the directions in the applicable instruction manual for adjusting the units gain, calibration, or sweep controls.

When the plug-in units are changed, the FOCUS and ASTIG. controls on the Type RM561A may have to be readjusted.

The Type RM561A may be operated with only one plug-in unit if desired. For example, moving film recording instrument may be used in place of a sweep plug-in unit. However, it will be necessary to elevate the unconnected crt deflection plates to about +170 to +210 volts dc for vertical, +150 to +180 volts dc for horizontal, to obtain proper focus and astigmatism control.

Operation of Controls

The POWER AND SCALE ILLUM. switch control turns the instrument on or off and adjusts the brightness of the graticule markings.

The FOCUS control permits proper trace or spot focus for most intensity values.

The ASTIG. control works in conjunction with the FOCUS control, to assure proper focus over the entire crt display.

The INTENSITY control changes the crt display brightness.

The TRACE ALIGNMENT control permits electronic tilting the level of the crt trace to agree with the horizontal graticule markings.

The 7-position CALIBRATOR switch determines the peak-to-peak amplitude of the signal at the CAL. OUT connector. It also turns the Calibrator off. The calibrator output is useful for setting the gain of amplifier plug-in units and checking the basic timing of time-base units.

NOTE

When using the calibrator output to set the gain of a plug-in amplifier, connect the outer conductor of the CAL. OUT connector to the chassis of the plug-in unit. Otherwise, the current through the calibrator ground resistor (R899) may cause the plug-in input from the calibrator to be inaccurate.

The CRT CATHODE SELECTOR switch on the rear panel lets the operator select either (1) internal CHOPPED BLANKING which blanks the crt while the spot switches between traces during multi-trace operation, or (2) EXT CRT CATHODE which lets external signals be used for crt Z-axis intensity modulation.

The two jacks located to the side of the CRT CATHODE SELECTOR switch labeled EXT CRT CATHODE and GND are the jacks to be used in (2) above. Normally a shorting plug is placed between the two jacks. The shorting plug must be removed when external Z-axis intensifying signals are used.

If the vertical plug-in unit does not have a chopped (or multi-trace) mode of operation, leave the CRT CATHODE SELECTOR switch in its position toward the jacks. This connects the crt cathode circuit to ground through the shorting plug during normal operation.

Display Combinations

The plug-in unit in the right-hand opening of the Type RM561A controls the horizontal (X-axis) deflection of the crt beam. The unit in the left-hand opening controls the vertical (Y-axis) deflection.

Conventional Display

To obtain the conventional display of a horizontal sweep with vertical deflection by the input signal, insert a time-base plug-in unit on the right and an amplifier unit on the left. If a vertical sweep is desired with the input signal displayed horizontally, insert the time-base unit on the left, and the amplifier on the right.

X-Y Display

To obtain an X-Y display, insert amplifier plug-in units in both plug-in openings. Plug-in units with equal phase shift will produce accurate X-Y displays.

Intensity Modulation Display

Intensity (Z-axis) modulation of the crt beam is possible through the EXT CRT CATHODE jack on the rear of the instrument. Depending on the setting of the INTENSITY control, a negative pulse of 5 volts or more will turn on the crt beam.

To accomplish Z-axis modulation, remove the shorting plug at the rear of the instrument, apply the Z-axis signal to the EXT CRT CATHODE jack, and set the CRT CATHODE SELECTOR switch to the EXT CRT CATHODE position.

Display Photography

To photograph recurrent traces:

1. Adjust the oscilloscope INTENSITY, FOCUS, and ASTIGMATISM controls for the sharpest trace of useful brightness.

2. Carefully adjust the SCALE ILLUM. control so the brightness of the graticule lines equal that of the trace.

3. Carefully focus the camera on the trace after setting the lens to its largest opening (smallest f-stop number).

4. Set the exposure time and the lens opening to take the photograph.

The exposure time should be long enough to record at least 5 sweeps of the electron beam to keep part of the display from being brighter than the rest. An exposure of 1 second is convenient because a wide range of lens openings can be used to accomodate various sweep rates.

Experience will determine which lens setting is best for the taking of photographs.

Blank Chassis

Blank-chassis plug-in units are available through your local Tektronix Field Office as Modification Kit number 040-245. Blank chassis permit you to built your own plug-in unit for use in the Type RM561A.

Heat Dissipation—Plug-in unit circuitry should not elevate the instrument temperature above the limits discussed previously under Cooling.

SECTION 4

CIRCUIT DESCRIPTION

Introduction

The Tektronix Type RM561A Oscilloscope has a low-voltage power supply circuit, a cathode-ray tube circuit, and a calibrator.

The low-voltage power supply circuit provides the regulated and unregulated power used by the instrument and the plug-in units.

The crt circuit has the necessary controls and input facilities needed to give a sharp trace of useable intensity, Two negative high-voltage power supply outputs are used for the cathode, focus element, and control grid of the crt.

The calibrator produces amplitude-calibrated square waves.

LOW-VOLTAGE POWER SUPPLY

The low-voltage power supply circuits have regulated outputs of —100, —12.2, +125, and —300 volts, and unregulated output of +420 volts. These circuits use silicon diode rectifiers and series-regulators. Each regulator circuit has a vacuum tube (or transistor, in the case of the —12.2-volt supply) in series with the load. This tube's series plate resistance (and current) is controlled to maintain a constant voltage drop across the load. For example, if the load increases the series tube plate resistance decreases to pass more current to the load. If the load decreases it passes less current. In both cases, the voltage across the load remains the same.

The —100-, +125-, and +300 volt regulated supplies require shunt resistors when supplying more current than can be handled by the series tube. A shunt allows some of the load current to bypass the supply-series-regulator tube. The size of the shunt is very important. If the shunt resistance is too high, the series tube can overheat; if the resistance is too low, the supply can fail to regulate. If a plug-in draws an amount of current that calls for a supply shunt, the correct shunt resistance is located in that plug-in unit. When the unit is plugged into the Type RM561A, the shunt is connected around the series regulator tube. The plug-in portion of the shunt is always in series with a 2 k ($1/2$ of a 4 k) resistor located in each power supply circuit.

Power for the Type RM561A Oscilloscope and its plug-in units is supplied through the power transformer T601. The two primary windings of T601 are connected in parallel for 117-volt operation, or in series for 234-volt operation, as shown on the schematic diagram.

—100-Volt Supply

Reference voltage for the —100-volt supply is established by the gas diode, V609. The constant voltage drop across V609 establishes a fixed potential of about —85 volts at the grid of 634B. Voltage at the grid of V634A is established by the divider R616, R617, and R618. The difference in voltage between the two grids of V634 determines the plate current of V634A. Plate current of V634A determines the base voltage of transistor Q624 which in turn determines the grid voltage of the series tube, V627. The series tube plate resistance changes to hold the load voltage constant. R616, —100 VOLTS adjustment, determines the percentage of the total divider voltage applied to the grid of V634A and thus controls the output voltage. When this control is properly adjusted, the output is exactly —100 volts.

Should the output voltage tend to change because of a change in input voltage or a change in load current, the potential at the grid of V634A will change a proportional amount. Any change at the grid of V634A is amplified by V634A and Q624 and applied to the grid of V627. The resulting grid change at V627 will cause its plate resistance to change in the direction needed to bring the output back to —100 volts. C616 improves the response of the regulator to sudden changes in output voltage. R628 is part of the series tube shunt, connected by some plug-in units.

+125-Volt Supply

The —100-volt supply serves as a reference for the +125-volt supply. With the R651 end of the divider R650-R651 fixed at —100 volts, any change in the +125-volt output produces a proportional change at the grid of V654. This change is amplified and supplied to the grid of the series regulator tube, V667A. The change at the grid of V667A changes its plate resistance to bring the output voltage back to +125 volts. R656, the +125 VOLTS control, determines the percentage of total divider voltage applied to the grid of V654 and permits adjustment of the output voltage. When this control is properly adjusted, the output is exactly +125 volts. C650 improves the response of the regulator to sudden changes in output voltage. R666 is part of the series tube shunt.

+300-Volt Supply

The +300-volt supply works the same as the +125-volt supply. To supply the voltage for the +300-volt regulator, rectified voltage from the transformer terminals 21 and 22 is added to the voltage supplying the +125-volt regulator. R676, the +300 VOLTS control, adjusts the output voltage.

The +300-volt supply has an unregulated output of +420-volts for the crt circuit.

—12.2-Volt Supply

Operation of the —12.2-volt regulating circuit is essentially the same as that of the other regulating circuits, except that transistors are used instead of vacuum tubes. The base of Q734 is fixed near —12 volts by the voltage divider R731-R732 between —100 volts and ground. Any variation of the —12.2-volt output at the emitter of Q734 is amplified by Q734 and Q744 to change the collector resistance of Q757 which is in series with the load. R730, the —12.2 VOLTS control, allows adjustment of the voltage

applied to the base of Q734 and thus the output voltage. When this control is properly adjusted, the output is exactly —12.2 volts. F720 protects Q757 in case of an overload on the —12.2-volt supply.

CRT CIRCUIT

The crt circuit contains the cathode-ray tube and two high-voltage supplies (one for the crt and focus element, the other for the control grid). The circuit also contains the necessary controls and signal input facilities.

Cathode-Ray Tube

A Tektronix T5610-31-1 ceramic-envelope cathode- ray tube is used in the Type RM561A. The accelerating voltage is approximately 3500 volts, developed by about —3300 volts at the cathode and an average deflection plate voltage of about +200 volts. With this accelerating voltage, the nominal vertical and horizontal deflection factors are 19.5 and 18.4 volts per centimeter respectively.

Deflection blanking of the crt beam is used in the Type RM561A. The crt contains a special set of deflection plates, pins 6 and 7, for this purpose. Both plates are connected to +125 volts; however pin 6 is also driven by the horizontal plug-in unit.

During sweep time, or if no plug-in unit is installed, both plates rest at +125 volts and permit the electron beam to pass on to the crt phosphor. During sweep retrace, however, pin 6 is driven considerably away from +125 volts by the right-hand plug-in unit. This scatters the beam and prevents it from being displayed.

High-Voltage Supplies

Energy for both high-voltage supplies is furnished by T801. V800, the primary of T801, and the stray circuit capacitance form a Hartley oscillator which operates at about 45 kc.

The output of one secondary winding of T801, rectified by V822, provides voltage for the crt cathode and focus element. This voltage is about —3300 volts at the crt cathode, and between about —2200 and —3000 volts at the focusing element, depending on the setting of the FOCUS control. The 6.3-volt crt heater is elevated to the cathode potential by R851.

The output of the other secondary winding of T801 is rectified by V832 for the control grid. The grid voltage ranges from —3200 to —3450 volts, depending on the setting of the INTENSITY control. The reference to ground for this supply is determined by the voltage at the junction of diodes D838 and D839. The voltage at this junction, plus the setting of the INTENSITY control, determines the crt bias and therefore the intensity of the display.

Two neon bulbs, B856 and B857, keep the voltage between the grid and cathode of the crt within safe limits. If the voltage exceeds about 140 volts, the neons fire and the voltage reduces to about 120 volts.

Regulation of the —3300-volt supply is accomplished through feedback from the arm of R841. The —3450-volt supply is regulated indirectly by mutual coupling in T801. If, because of loading or a change in input voltage, the output of the —3300-volt supply changes, a proportionate change occurs at the arm of R841. This change is amplified by V814 and is coupled to the screen of V800. The resulting change in screen voltage of V800 will increase or decrease the amplitude of oscillations in V800, changing the output voltage of T801 in the direction needed to return the high voltage to the correct level. The HIGH VOLTAGE control, R841, permits adjustment of the output voltage by setting the bias on V814B.

Deflection Signals

Push-pull signals for the deflection plates appear at pins 17 and 21 of the plug-in connector. The effective deflection-circuit capacitance these signals see at the connector affects the bandpass and phase shift of each plug-in unit. C760 and C761 (Interconnecting Socket diagram) are set at the factory.

Intensifying Signals

Two signals may be used to modulate the intensity of the crt display. First, intensifying signals from a two-sweep (delaying-sweep) time-base plug-in unit are applied to the grid supply through terminal 14 of the right-hand Interconnecting Socket. When the overall display intensity is reduced with the INTENSITY control, positive intensifying pulses from a two-sweep time-base plug-in unit will brighten any desired portion of the display.

The ground return for the crt grid supply can be either through D838 in the case where the plug-in unit does not supply intensifying signals or through D839 to a negative voltage in the intensifying circuit of the plug-in unit. In the second case D838 is back-biased and the junction of D838 and D839 is at a low negative voltage. With the same setting of the INTENSITY control, the first case will provide a brighter display. The second case provides a slightly dimmer display due to the plug-in unit negative voltage. Intensification results when the plug-in unit positive pulse turns D839 off and the crt grid supply return again becomes D838. R837 and C837 then couple the leading edge of the intensifying pulse directly to the crt grid.

Other external intensifying signals can be fed to the crt cathode through the EXT CRT CATHODE jack. Depending on the setting of the INTENSITY control, a negative pulse of 5 volts or more will turn the crt beam on.

Crt Controls

The INTENSITY control, R833, has a range of about 250 volts to control the crt bias and permit changing the intensity of the display.

The FOCUS control, R844, adjusts the focus of the crt by varying the voltage at the focusing anode through a range from about —2200 to —3000 volts.

The ASTIG. control, R864, has a 300-volt adjustment range.

The GEOMETRY control, R865, adjusts the geometry by varying the voltage of the crt isolation shield through a range from +180 to +246 volts.

The TRACE ALIGNMENT control, R860, rotates the display so it can be aligned with the graticule.

CALIBRATOR

The calibrator for the Type RM561A Oscilloscope produces line-frequency amplitude-calibrated square waves. The 6.3-volt (approximately 18 volts peak-to-peak) ac heater voltage for V884 is applied through C876 to the cathode of V884A. The signal at the plate of V884A is coupled to the grid of V884B to turn that tube on and off. Regenerative feedback from the plate of V884B to the grid of V884A speeds up the switching action, and drives V884A into and out of cutoff.

The voltage present at the cathode of V884B during the time that V884B is conducting is adjusted to exactly 100 volts with the CAL. AMPL. adjustment, R871. The voltage divider in the cathode circuit of V884B contains precision resistors to provide an output accuracy of 3% or better at the various settings of the CALIBRATOR control.

When the CALIBRATOR control is set to the 1V position, there will be a 0.1-volt output when the CAL. OUT connector is terminated in 50 ohms.

NOTES

SECTION 5

MAINTENANCE AND CALIBRATION

MECHANICAL MAINTENANCE

Cleaning

Occasionally blow the dust out of the instrument with a low-velocity dry air stream. Remove persistant dirt with a small paint brush or damp cloth. The screen on the fan can be snapped out and should be cleaned as needed, check it frequently.

Fan Oiling

The fan should be oiled with a few drops of oil about every six months. An industrial hypodermic syringe and needle is used to insert oil through a protective rubber cap located under the fan label. The oil recommended is Anderol L826 from the Lehigh Company or Rotron distributors, but if not available, a good light machine oil may be used. If a syringe and needle cannot be obtained locally, you can order them through your local Tektronix Field Office by specifying Hypodermic Syringe, Tektronix Part No. 003-282 and Hypodermic Needle, Tektronix Part No. 003-285.

Fig. 5-1 shows how to oil the fan. Place the needle at the point on the label shown in Fig. 5-1. With the needle at about 45°, pierce the label and rubber cap (located under the label); insert the needle about ¼" and depress the syringe-plunger to inject a few drops of oil.

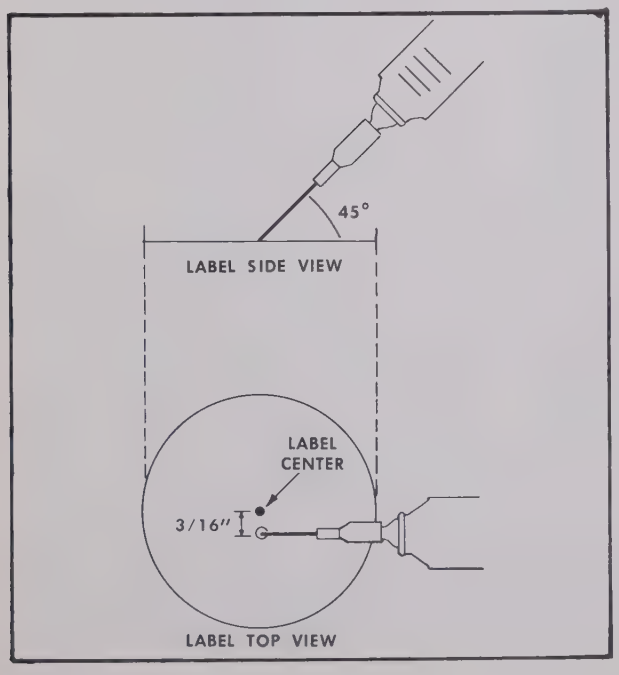


Fig. 5-1. Fan motor oiling with hypodermic.

ELECTRICAL MAINTENANCE

If trouble occurs in the Type RM561A Oscilloscope, a five-step procedure may be used for repair. First confirm the trouble. Next, isolate trouble to a plug-in unit or to the Type RM561A. Localize a trouble in the Type RM561A to the Power Supply, Crt Circuit, or Calibrator. Troubleshoot the correct circuit to find the defective parts. Replace the defective parts.

Confirmation of Trouble

Improper control settings may, at times, give indications of trouble. Therefore, you should be sure that the apparent trouble is not caused by improper front-panel control settings. For example, an improper setting of the SOURCE or COUPLING switch on a time-base unit can cause apparent triggering troubles; an improper setting of the VARIABLE control on an amplifier unit can cause an apparent decrease in sensitivity.

When a trouble exists, it must be isolated to one of the plug-in units or to the Type RM561A indicator.

Isolating Trouble

Isolating trouble to a plug-in unit or to the indicator can be done in one of two ways, depending on whether or not there are spare plug-in units available.

If trouble is found to be in the plug-in unit, refer to the instruction manual for that unit. A plug-in extension (Part Number 013-034, available through your local Tektronix Field Office) allows the units to be operated while extended out through the front of the plug-in opening.

Spare Plug-In Units Available

If more than two plug-in units are available, the easiest way to isolate trouble is to replace the plug-in units one at at time. The faulty unit can then be isolated by noting when proper operation is restored. If plug-in replacement does not correct the trouble, the Type RM561A is probably faulty.

NOTE

A non-sampling plug-in unit cannot be operated with a sampling plug-in unit.

Spare Plug-In Units Not Available

When spare plug-in units are not available, the crt display will be of great help. Trouble will normally show up as an erroneous display, or as no display at all. Since the crt display will help isolate the trouble, the following procedure is divided according to the type of display.

No Trace Or Spot. If no trace can be obtained on the crt, remove both plug-in units and vary the INTENSITY control. A spot should appear. If no spot appears, the trouble is in the Type RM561A. If a spot does appear when

both plug-in units are removed, reinsert each unit separately. After warmup, vary its POSITION control. If the spot or trace cannot be returned to the approximate center of the crt when a single plug-in unit is in the indicator, the trouble is probably in that unit. (If a time-base unit is installed, be sure it is set for free-running operation to unblank the crt).

Insufficient Vertical Deflection or Improper Sweep Timing. If the plug-in unit front-panel gain controls do not permit adequate vertical deflection or proper sweep timing, check the low-voltage and high-voltage power supply voltages (see schematics).

If the power-supply voltages are not correct, remove both plug-in units and check the voltages again. If they still are not correct, the trouble is in the Type RM561A indicator. If the power-supply voltages are correct with both plug-in units removed, but incorrect with only one of the two inserted, the trouble is in that unit. If the power-supply voltages are correct with both plug-in units removed, but incorrect when either is inserted, the trouble is probably in the power supply of the Type RM561A.

Improper Triggering. If external triggering and line triggering are satisfactory, but internal triggering is not, the trouble is probably in the Trigger Pickoff Circuit of the amplifier plug-in units. If satisfactory triggering cannot be obtained from any of the three sources (external, internal or line) the trouble is probably in the time-base plug-in unit.

Waveform Distortion. If there is any waveform distortion, but no other indications of malfunction (such as improper sweep timing) the trouble is probably in the vertical plug-in unit.

Localizing Trouble In Type RM561A Indicator

If it has been determined that trouble exists in the Type RM561A, the location of the trouble can be further localized to the Power Supply, the Crt Circuit, or the Calibrator.

To localize the trouble to either the Power Supply or the Crt Circuit, measure the output of each of the regulated power supplies. If incorrect voltages are measured, the trouble is in the Power Supply or the power source. If all of the measured voltages are proper, the trouble is in the Crt Circuit.

Trouble in the Calibrator is indicated by an erroneous output at the CAL. OUT connector.

When it is known which circuit contains the trouble, that circuit can be checked to locate the defective component.

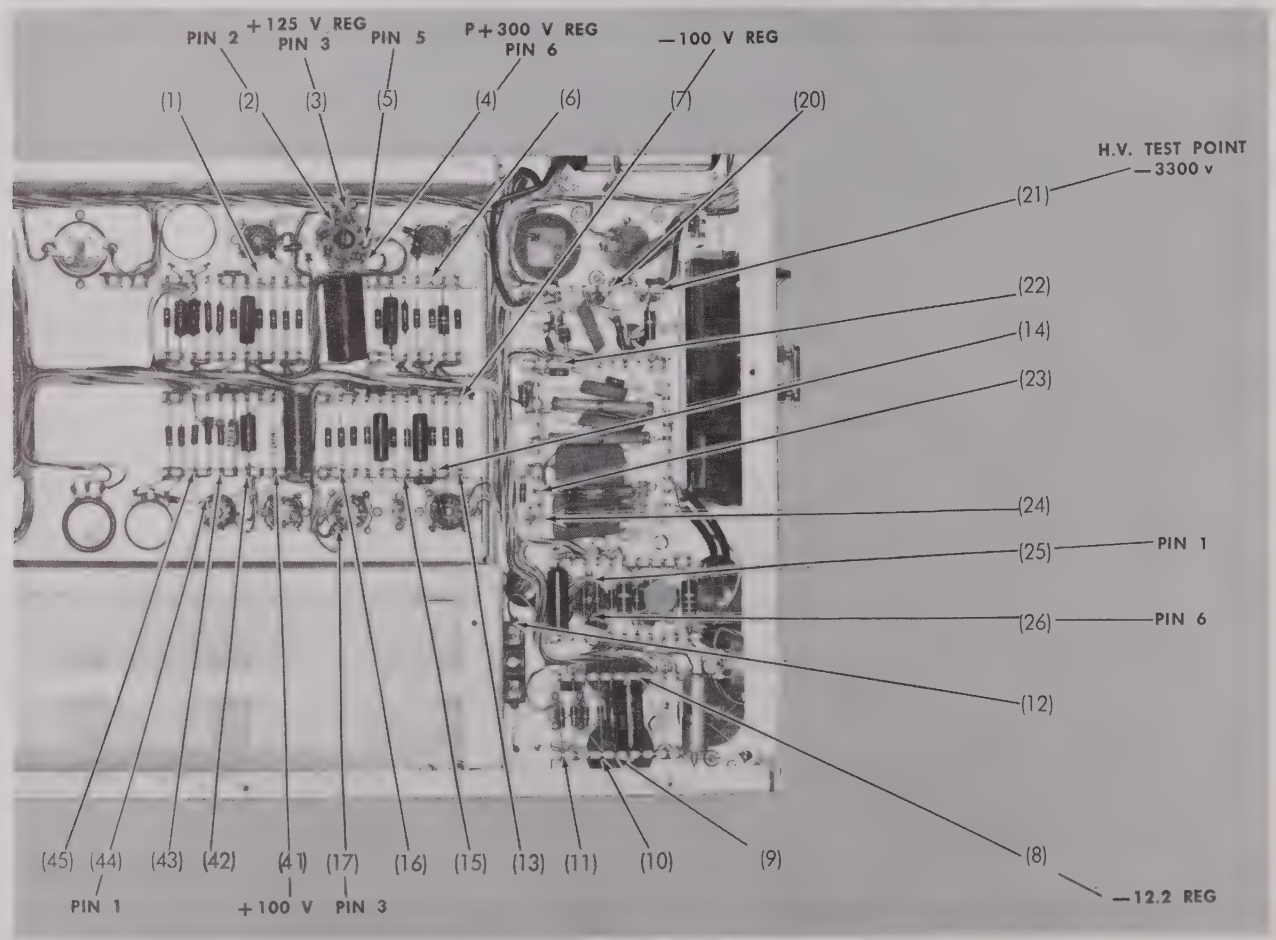


Fig. 5-2. Power-Supply test points (1) through (17). CRT Circuit test points, (20) through (26). Calibrator test points (41) through (45).

Circuit Troubleshooting

In troubleshooting a circuit, broken wires, worn switches, scorched parts, and improperly seated tubes can be found by visual inspection. (Before a scorched part is replaced, the cause of the scorching should be eliminated.)

Tube failure is the most prevalent cause of trouble in Tektronix instruments. Therefore, if a visual check fails to reveal the cause of trouble, all tubes should be checked as the next step. Tubes should be checked by substitution, one at a time. (Tube-testers cannot adequately check all parameters.) Be sure to return all good tubes to their original sockets; otherwise the instrument may have to be recalibrated unnecessarily because of different characteristics of the same tube type.

If tube substitution does not correct the trouble, then check the rest of the circuit by voltage and resistance measurements. Voltages at various test points throughout the instrument are indicated on the schematics. The test points can easily be located using Fig. 5-2. The voltages at the test points are typical and may vary considerably from instrument to instrument. Resistance measurements in a circuit will usually be point-to-point checks for which the proper values can be approximated from the schematic diagrams. Table 5-1 may be used as an aid in relating trouble symptoms to the probable cause and the procedure to use to locate the defective component. Voltages listed in the table were obtained with the Type RM561A operated without plug-in units.

All signal wiring in the Type RM561A is colored to make circuit tracing easier. In addition, all regulated power supply leads are color coded to follow the standard EIA code. The first color (widest strips) indicates the first number of the voltage. The second color indicates the second and the third color (smallest stripe) indicates the multiplier. The voltage is positive if the main color of the wire is white and negative if the main color of the wire is tan. Four colors would be required to indicate all the digits plus a multiplier for the +125-volt leads. To avoid this, the +125-volt leads are coded as +120; that is, brown, red, brown on a white base. A —100-volt lead is coded brown, black, brown on a tan base while +300-volt leads are coded orange, black, brown on white.

The switch wafer shown on the Calibrator diagram is coded. The letters F and R indicate whether the front or rear of the wafer is used to perform the particular switching function.

TABLE 5-1

RM561A Troubleshooting Table

Symptoms	Checks
—100-Volt Supply (Any change in this supply may change instrument calibration.)	
1. Incorrect output level, ripple, or regulation.	A. Check line voltage. B. Check setting of —100 volts adjustment (see calibration procedure). C. Check V609, V634, V627, and Q624 by substitution. D. If output still incorrect go to whichever symptoms apply of 2 through 7.
2. Output voltage high (too negative).	A. Check voltage at test point [14]: about —80 vdc. (Incorrect: check V634B grid circuit components.) B. Measure V634 bias, between pin 7 of V609 and pin 8 of V634: about 2 v. Use meter that can be elevated. (If bias is excessive check R618 and R616.) C. Check R618, R616, R634, R633, and R624.
3. Output voltage low (too positive).	A. Check voltage between terminals 17 and 18 of T601: 137 vac ±10% at 117 (or 234) volt line. (Incorrect: check T601 primary circuit.) B. Check voltage between C640A terminals: about 175 vdc ±10%. (Incorrect: check C640A, C640B, R640, and D640.) C. Check test point [14]: about —80-vdc. (Incorrect: check V609.) D. Check R617, R616, C616, C640B.
4. Poor regulation at either high, low or normal line voltage. (Supply should hold regulation within ±1% throughout normal line voltage range.)	A. Check for correct output voltage before checking regulation—also, check output voltage after regulation trouble is fixed. B. Check voltage at test point [17]: about +85 vdc. (Voltage low: check D640 and do checks 2A, 2B, and 2C.) C. Check for excessive loading by either plug-in unit or RM561A circuits.
5. Poor regulation at low line voltage.	Check R635, R628 and shunt resistors in plug-in unit.
6. Poor regulation at high line voltage.	Substitute another plug-in unit. (Symptom occurs if load is reduced while shunt resistor remains the same in plug-in unit.)
7. Excessive ripple.	A. Check for correct output voltage and regulation before checking ripple—also check output voltage and regulation after ripple trouble is fixed. B. Check voltage at test point [17]: about +85 vdc. C. Check ripple at test point [17]: should be less than 25 v peak-to-peak with load. (Excessive: check C640A and D640.) D. Check tubes. E. Check C616, C611, C640A and C640B.
+125-Volt Supply (Any change in this supply may change instrument calibration.)	
8. Incorrect output level, ripple, or regulation.	A. Check line voltage. B. Check —100 volts supply voltage and ripple at test point [7].

TABLE 5-1 *(Cont'd)*

Symptoms	Checks
	C. Check setting of +125 VOLTS adjustment (see calibration procedure). D. Check V654, V667. E. If output still incorrect go to whatever symptoms apply of steps 9 through 14.
9. Output voltage high.	A. Check voltage at test point [1]: about +68 vdc. (Incorrect: check R657, R658, and V654.) B. Check R650.
10. Output voltage low.	A. Check voltage between terminals 19 and 20 of T601: 160 vac ±10%. (Incorrect: check primary circuit.) B. Check voltage at test point [2]: +215 vdc. (Incorrect: check C642A, R642, D642.) C. Check test point [1]: about +68vdc. (Incorrect: check R659, V654.) D. Check C650, R651.
11. Poor regulation at either high, low or normal line. (Supply should hold regulation within 1% throughout normal line voltage range.)	A. Check for correct output voltage before checking regulation—also, check output voltage after regulation trouble is fixed. B. Check tubes. C. Check voltage at test point [2]: about +215 vdc. (Incorrect: do checks 10A and 10B.)
12. Poor regulation at low line voltage.	Check R653, C650, R666, and shunt resistors in plug-in units.
13. Poor regulation at high line voltage.	A. Check C650. B. Substitute another plug-in unit. (Symptom occurs if load is reduced while shunt resistor remains the same in plug-in unit.)
14. Excessive ripple.	A. Check for correct output voltage and regulation before checking ripple—also, check output voltage and regulation after ripple trouble is fixed. B. Check tubes. C. Check voltage at test point [2]: about +215 vdc. (Incorrect: do checks 10A and 10B.) D. Check voltage at test point [1]: about +68 vdc. (Incorrect: check R657, R659, R658.) E. Check C642A, and B, C650, D642.
	+300-Volt Supply
	Symptoms and checks similar to those described for the +125 volt supply.
	—12.2-Volt Supply
	(Any change in this supply may change instrument calibration.)
15. Incorrect output level, ripple or regulation.	A. Check line voltage. B. Check —100 volts supply output test point [7]. C. Check setting of —12.2 VOLTS adjustment (see calibration procedure).

TABLE 5-1 *(Cont'd)*

Symptoms	Checks
	D. Check Q734, Q744, Q757, and F720. E. If output still incorrect go to whichever symptoms apply to steps 16 through 20.
16. Output high (too negative).	A. Check test point [9]: about —12 vdc. (Incorrect: check C732, R732.) B. Check test point [10]: about +7.9 vdc. (Incorrect: check R734, C737.) C. Check C737, R734, R744.
17. Output low or zero, (too positive).	A. Check voltage between terminals 14 and 15 then 15 and 16 of T601: 15 vac ±10% with 117 (234) vac line. (Incorrect: check transformer primary circuit.) B. Check voltage between C720A and B terminals, test points [8] and [12]: about 18 vdc. (Incorrect: check C720A, C720B, D720, D721.) C. Check voltage at fuse F720: about +8.2 vdc. (Incorrect: check C757 and F720.) D. Check test point [9]: about —12 vdc. (Incorrect: check R731.) E. Check test point [10]: about +7.9 vdc. (Incorrect: check R735.) F. Check C757.
18. Poor regulation at either high, low or normal line voltage. (Supply should hold regulation with ±1% throughout normal line voltage range.)	A. Check for correct output voltage before checking regulation—also, check output voltage after regulation trouble is fixed. B. Check for excessive loading by either plug-in units or RM561A circuits.
19. Poor regulation at low or high line voltage.	Check R734, R735, R744, and C737.
20. Excessive ripple.	A. Check for correct output voltage and regulation before checking ripple—also, check output voltage and regulation after ripple trouble is fixed. B. Check ripple at test point [12]: should be less than 4 v peak-to-peak with load. (Excessive: do checks 17A and B.) C. Check D720, D721, C720A and B, C732, C757.
	CRT Circuit
	(Any change in this circuit may change display vertical and horizontal calibration.)
21. Any incorrect operation of CRT circuit.	A. Check line voltage. B. Check HIGH VOLTAGE adjustment, (—3300 volts at test point [21], see calibration procedure). If minor adjustment restores operation, circuit may be normal. C. Check V822 and V832 heaters for color:

TABLE 5-1 *(Cont'd)*

Symptoms	Checks
	dull orange—normal bright—heavy load on either tube dim—poor tube (replace) both dark—oscillator inoperative D. If operation still incorrect, go to whichever symptoms apply of 22 through 29.
22. Low intensity.	A. Check intensity control setting. B. Check V822 and R835. C. Unblanking pulse doesn't return pin 6 of crt fully to +125 v. D. Check crt.
23. High intensity.	A. Check intensity control setting. B. Check R833, C837, C830, and C832.
24. No intensity.	A. Check intensity control setting. B. Make sure spot or trace is not deflected off screen. (Spot should appear near center with both plug-in units removed.) C. V822 heater open, (B856 and B857 glowing brightly show V822 open). If V822 is open check V814A. D. Check oscillator tubes and circuit including T801. E. Check C822, C842, and crt.
25. Poor astigmatism and/or focus.	A. Check FOCUS and ASTIG. control settings. B. Check HIGH VOLTAGE at pin 2 of crt, test point [20]: —3300 vdc. (Incorrect: check R852). C. Check voltage at pin 9 of crt: O to +300 vdc when ASTIG. control is rotated. (Incorrect: check R864 and +300 vdc to R864.)
26. Blooming(size of display increases with intensity increase.)	Check V800 and V822 (either may be weak.)
27. No intensifying pulse.	A. D838 shorted, D839 open. B. C837 or R837 open (leading edge of long intensifying pulse missing.)
28. No Z-axis modulation or no chopped blanking.	C853 or R853 open. If R853 open check for shorted C853.
29. Intensity varies (unwanted Z-axis modulation).	D838 and/or D839 open.
CALIBRATOR	
30. Incorrect outputs.	A. Check CAL. AMPL. adjustment (see calibration procedure). B. Check V884. C. Check voltages at test points [41 though 45], D. Use calibration procedure, check divider in V884B cathode.

Replacing Parts

Most parts in the Type RM561A Oscilloscope can be replaced without detailed instructions. Some parts, however, should be replaced by using definite procedures. These procedures are described in the following paragraphs.

A replaced part may affect instrument calibration. Check and adjust where needed.

Soldering Precautions and Procedure

In Tektronix instruments, parts are connected to ceramic terminal strip notches with solder containing about 3% silver. The bond between the notch and ceramic strip may be broken by repeated use of ordinary 60-40 tin-lead solder or by excessive heat Therefore, when resoldering parts to a ceramic strip use solder containing 3% silver and do not overheat the work. Occasional use of ordinary solder, however, will not break the bond.

Usually 3% silver solder is available locally; or one-pound rolls may be purchased through your Tektronix Field Office by ordering Tektronix Part Number 251-514.

The following soldering procedure may be used to remove and replace parts on a ceramic terminal strip.

1. Use 50- to 70-watt soldering iron with a wedge shaped tip. (With this type tip you can heat the solder slot without overheating the strip.)

2. Tin the soldering iron tip with silver-bearing solder.

3. Heat the parts soldered to the ceramic strip only enough to make the solder flow freely. Do this by touching one corner of the soldering iron tip to the notch. (Be careful: excessive pressure will break the ceramic strip.)

4. When you remove a part, pull its lead out of the notch while the solder is hot.

5. When you replace a part use only enough solder to cover the wires and form a small fillet in the notch.

6. Clip excess leads of parts replaced and be sure to remove all clippings from the instrument.

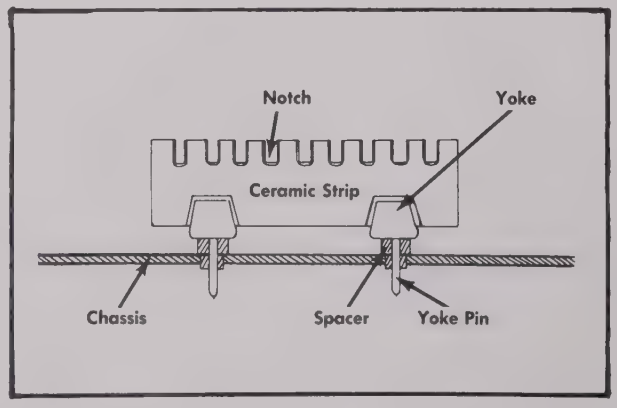


Fig. 5-3. Ceramic terminal strip assembly.

Replacing Ceramic Terminal Strips

Damaged ceramic terminal strips can be replaced by the following procedure. Fig. 5-3 shows how ceramic strip parts are assembled.

1. Unsolder all connections to damaged ceramic strip.

2. Cut off one side of each plastic yoke holding the old ceramic strip.

3. Remove old ceramic strip.

4. Remove remainder of old yokes from spacers.

5. Replace old spacers with new ones. (If not damaged, spacers can be reused.)

6. Set new ceramic strip yoke pins into spacers.

7. Drive new yoke pins completely into spacers by pressing or lightly tapping the ceramic strip directly above the yokes. Be careful, don't break strips.

8. Cut off portion of new yoke pins protruding through spacers on side of chassis opposite the ceramic strip.

9. Resolder connections to new ceramic strip using the information headed Soldering Precautions and Procedure.

Replacing Calibrator Switch

The entire switch should be replaced and can be ordered either wired or unwired.

Cathode-Ray Tube

WARNING

When replacing crt, wear a plastic face mask and protective gloves for protection in case tube implodes.

To remove the cathode-ray tube, disconnect the four leads connected to the neck of the tube, the tube socket, and loosen the tube clamp on tube base. Remove the crt bezel, light reflector, and light shield. Pull the crt straight out through the front panel, being careful not to bend or break the crt neck pins. The rubber gasket and implosion shield can be removed from the crt face after it is out of the instrument.

Install the new crt by the reverse of the preceding procedure. When replacing the implosion shield be sure that the notched side is down. Follow the color-code information on the tube shield when the crt neck pins leads are replaced. When the crt is properly installed, the back of its faceplate is flush with the instrument front panel.

After the crt is replaced, it may be necessary to adjust the TRACE ALIGNMENT and HIGH VOLTAGE controls and the deflection-circuit capacitance (C760 and C761) according to the calibration procedure. Also check the calibration of time-base and amplifier plug-in units.

CALIBRATION

The Type RM561 Oscilloscope should be calibrated after each 500 hours of operation, or every six months, whichever occurs first. In addition, the calibration should be checked and adjusted as necessary after replacement of any part.

Normally, when only the Type RM561A is calibrated, two operating plug-in units are used. If both the Type RM561A and the plug-in units are calibrated, the indicator unit is calibrated first. If only the plug-in units are calibrated, first check the Type RM561A power-supply output voltages to eliminate errors caused when these voltages are incorrect.

Equipment Required

1. Dc voltmeter, at least 20,000 ohms per volts. 1% from 0 to 300 volts (use 0.5% accuracy meter when the Type RM651A is used with sampling type plug-in units), ±3% at 4000 volts.

2. Variable autotransformer: 250-watt minimum output, 105-125 v or 210-250 v.

3. Ac voltmeter (rms) ±3% from 0 to 250 volts.

4. Test oscilloscope: vertical sensitivity of at least 50 millivolts/division (for ripple measurement).

5. Capacitance meter capable of measurement accuracy of 0.3 picofarad or better at 3-10 picofarads; meter must have guard circuit available to measure 3 terminal capacitance circuits. Tektronix Type 130 L-C Meter recommended.

Procedure

Preliminary

The following preliminary procedure must be performed before beginning the calibration.

1. Remove both top and bottom covers from the instrument cabinet.

2. Connect the instrument through the autotransformer to a line-voltage source.

3. Turn on the instrument and allow a ten-minute warm-up.

4. Monitor the transformer output with the ac voltmeter and set the transformer for the correct operating voltage (117 or 234 volts).

Power Supply Adjustment

If the sampling type plug-in units are to be used in the Type RM561A, the power supply tolerances are ±1%. If not, the tolerances are ±2%. Power supplies are within 1% when shipped from the factory.

The —100-volt supply is the reference for the other supplies, therefore, it must always be adjusted first.

1. Connect the dc meter to the —100-volt test point [$_{11}$]. Adjust R616 (—100 VOLTS control) for —100 volts. Check regulation by varying the autotransformer from 105 to 125 volts (or 210 to 250 volts). The —100 volts should stay within 1%. Return the autotransformer output to 117 (or 234) volts.

2. Connect the meter to the +125-volt test point [$_{4}$]. Adjust R656 (+125 VOLTS control) for exactly +125 volts, and check regulation as in step 1 (within 1%).

3. Connect the meter to the +300-volt test point [5]. Adjust R676 (+300 VOLTS control) and check regulation (within 1%).

4. Connect the meter to the —12.2-volt test point [8]. Adjust R730 (—12.2 VOLTS control) for —12.2 volts, and check regulation (within 1%).

5. Switch the meter to the 4000-volt range, and connect it to high voltage test point [21] through the hole in the high voltage shield. Adjust R841 (HIGH VOLTAGE control) for —3300 volts.

Power Supply Ripple Check

With the test oscilloscope, measure the power supply ripple at each of the test points described in steps 1 through 4 of the preceding "Power Supply Adjustment" procedure. Do not measure ripple on the —3300-volt supply. Maximum allowable ripple for each supply is shown on the Power Supply schematic diagram.

Calibrator Adjustment

Turn the CALIBRATOR switch to OFF, and connect the dc meter to the calibrator test point [41]. Adjust R871 (CAL. AMPL. control) for exactly +100 volts. A check of each step of the CALIBRATOR switch can be made by using the following procedure. Ground the junction of C876, R876, and R887, test point [45]. Turning the CALIBRATOR switch will now leave the cathode of V884B at +100 volts (no output square-wave), and the ratio voltage of each cathode resistor will appear at the front-panel CAL. OUT connector. Connect a non-loading dc meter to the CAL. OUT connector, and check the voltage at each position of the CALIBRATOR switch. All voltages should be within 3% of the switch position voltage. Remove the ground from test point [45].

Trace Alignment

If you are using a time-base unit, set it for a free-running sweep. If you are not using a time-base unit or the time-base will not free-run, apply a signal to an amplifier unit in the right-hand side to produce a horizontal trace at least 10 graticule divisions long. Set the FOCUS and ASTIG. controls for the narrowest trace width and position the trace directly behind one of the graticule lines. Adjust the TRACE ALIGNMENT control to align the trace with the graticule line. Earth's magnetic field may change trace alignment when the oscilloscope is rotated.

Geometry

The GEOMETRY adjustment is set to achieve minimum curvature of vertical lines displayed at the edge of the graticule.

Insert a time-base unit into the right-hand opening and a vertical amplifier unit into the left-hand opening of the Type RM561A. Connect the output of the Calibrator to the vertical amplifier and adjust the time-base unit to display two to five cycles of signal. Adjust the amplitude and position of the display so the tops and bottoms of the pulses are just visible at the top and bottom of the crt. Then set the GEOMETRY adjustment to eliminate any curvature of the vertical lines located near the edge of the graticule.

Effective Deflection-Circuit Capacitance

The effective deflection-circuit capacitance connected to the output of either plug-in unit (horizontal or vertical) affects bandpass and phase-shift. The effective capacitance (about 14 picofarads) is adjusted in the Type RM561A by C760 and C761. C760 and C761 may have to be readjusted if the effective capacitance is changed by crt replacement or by capacitor misadjustment. Note, however, that incorrect effective deflection-circuit capacitance will not noticeably affect oscilloscope operation unless vertical amplifiers with a bandpass of 4 megacycles or more are used.

Effective deflection-circuit capacitance at each plug-in unit is a combination of capacitances between the Type RM561A chassis and interconnecting-socket terminals 17 and 21, as well as capacitance between terminals. C760 is part of the vertical effective capacitance and C761 is part of the horizontal effective capacitance as shown in Fig. 5-4.

Adjustment Procedure

NOTE

A non-sampling type vertical plug-in unit is calibrated for use as a standardized unit in the following procedures. The plug-in unit selected for this purpose should have the greatest bandpass used with your instrument. The greater the bandpass, the more accurate the adjustment can be made. In any case, the plug-in unit must have a bandpass of at least 4 megacycles. If such a plug-in unit is not available, or if one is not used with your instrument, you need not adjust the crt deflection-circuit capacitance.

The effective capacitance at pins 17 and 21 cannot be measured directly with a capacitance meter. Instead, each of the three capacitances is measured and the effective value is calculated.

Vertical Capacitance

1. Remove plug-in units, disconnect power cord and isolate the Type RM561A from ground.

2. Connect the capacitance meter guard circuit to terminal 21 of interconnecting socket and measure capacitance between terminal 17 and Type RM561A chassis; this is C1 in Fig. 5-4.

3. Connect meter guard circuit to terminal 17 and measure capacitance between terminal 21 and chassis; that is the value of C760.

4. Connect meter guard circuit to chassis. Measure the capacitance between pins 17 and 21; first with meter ground lead on pin 21; then with meter ground lead on pin 17. The average of the two measurements is the value of C2.

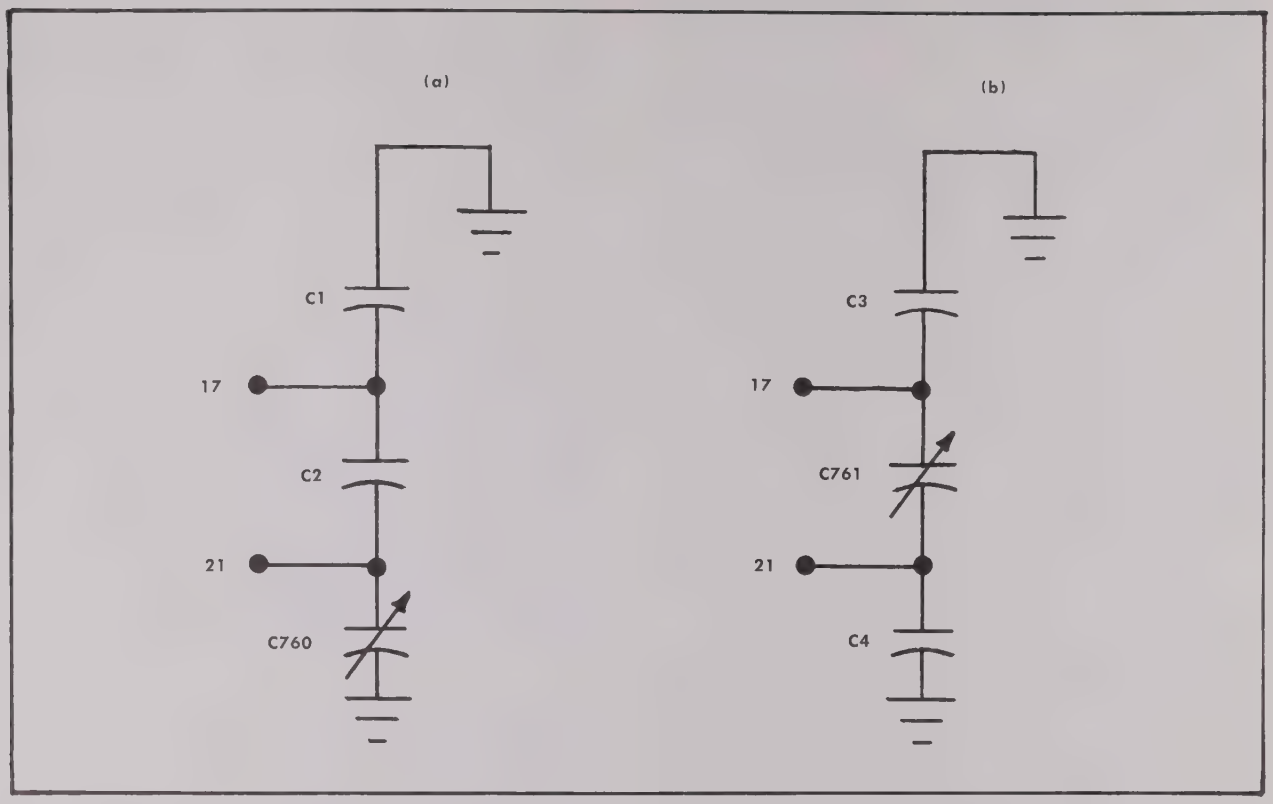


Fig. 5-4. Schematic representation of effective deflection-circuit capacitance at pins 17 and 21 of interconnecting sockets: (a) vertical socket, J11; (b) horizontal socket, J21.

5. Substitute the values obtained for C1, C760, and C2 into the following equation and solve for X:

$$X = 2C2 + \frac{C1 + C760}{2}$$

If the value for X is between 13.4 and 14.6 picofarads, capacitor C760 needs no adjustment, therefore go to the horizontal capacitance procedure to make sure C761 is adjusted properly.

6 If C670 needs adjusting (X in step 5 is not between 13.4 and 14.6 picofarads) calculate the desired value for C760 by substituting the values obtained for C1 and C2 in the formula:

$$C760 = 28\ pf - 4C2 - C1.$$

7. Connect the guard circuit to terminal 17 and adjust C760 until capacitance between terminal 21 and Type RM561A chassis equals the value calculated in step 6. Thus, the vertical effective deflection-circuit capacitance is adjusted to proper value.

Horizontal Capacitance

1. Connect power cord, insert a wide-band (at least 4 mcs) non-sampling plug-in unit in the properly adjusted left-hand opening of the Type RM561A, and a time-base unit into the right-hand opening.

2. Calibrate the vertical plug-in unit for best square wave response according to the calibration procedure in the plug-in unit instruction manual. This calibrated vertical plug-in unit can now be used as a standardized unit.

3. Interchange the position of the two plug-in units (vertical on right, time-base on left).

4. Apply the same calibration square wave to the standardized plug-in unit and adjust C761 for best square wave response. Thus, horizontal effective deflection-circuit capacitance is adjusted to proper value; that is, equal to vertical capacitance.

The standardized vertical plug-in unit can be used to calibrate the effective deflection-circuit capacitance of other Type RM 561A Oscilloscopes. Simply insert the standardized unit into an opening to be calibrated, and a time-base unit into the other opening. Apply the calibration square wave to the standardized unit and adjust C760 or C761 (whichever is applicable) for the best square wave response.

SECTION 6
PARTS LIST AND SCHEMATICS

PARTS ORDERING INFORMATION

Replacement parts are available from or through your local Tektronix Field Office.

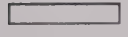
Changes to Tektronix instruments are sometimes made to accommodate improved components as they become available, and to give you the benefit of the latest circuit improvements developed in our engineering department. It is therefore important, when ordering parts, to include the following information in your order: Part number including any suffix, instrument type, serial number, and modification number if applicable.

If a part you have ordered has been replaced with a new or improved part, your local Tektronix Field Office will contact you concerning any change in part number.

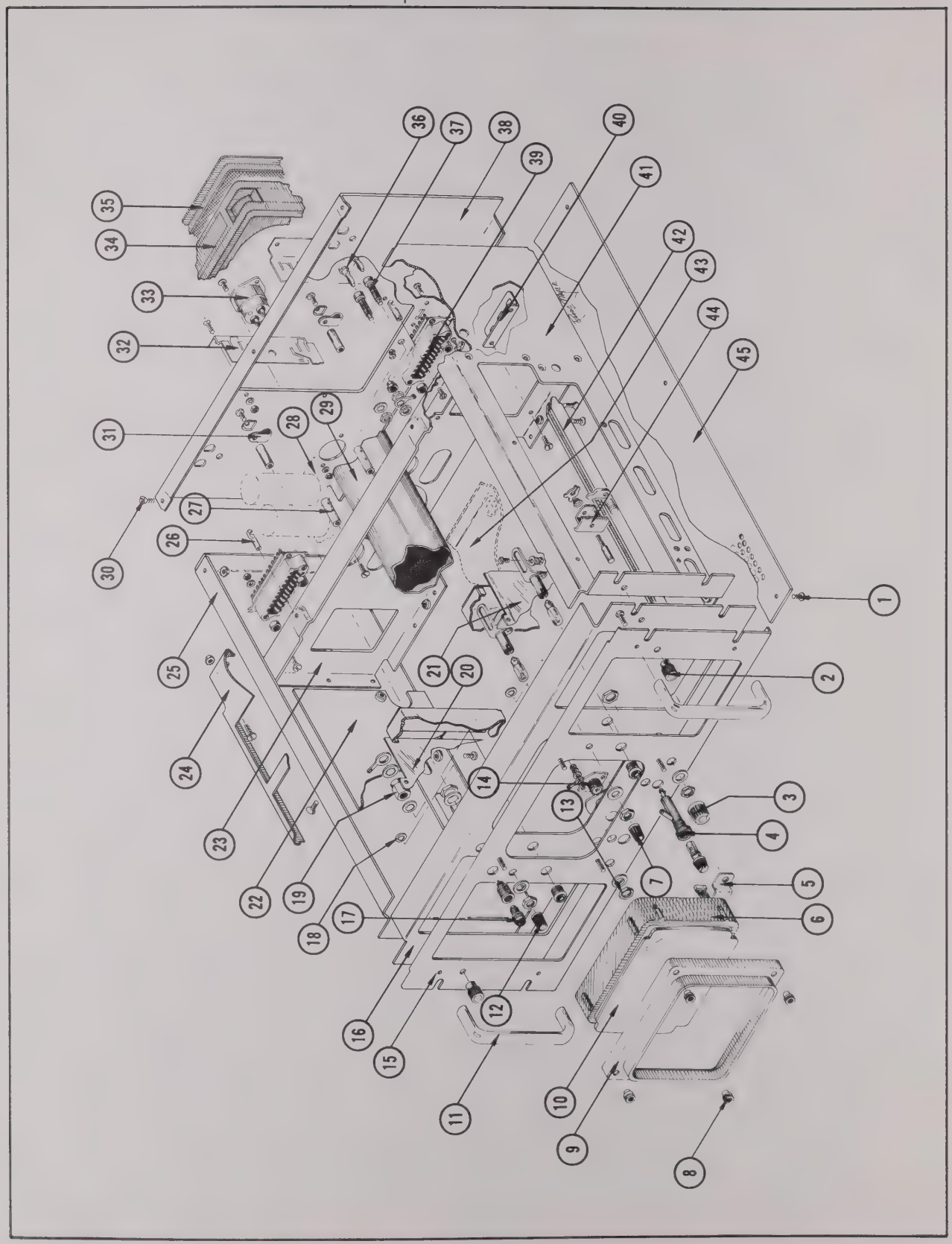
ABBREVIATIONS AND SYMBOLS

a or amp	amperes	mm	millimeter
BHS	binding head steel	meg or M	megohms or mega (10^6)
C	carbon	met.	metal
cer	ceramic	μ	micro, or 10^{-6}
cm	centimeter	n	nano, or 10^{-9}
comp	composition	Ω	ohm
cps	cycles per second	OD	outside diameter
crt	cathode-ray tube	OHS	oval head steel
CSK	counter sunk	p	pico, or 10^{-12}
dia	diameter	PHS	pan head steel
div	division	piv	peak inverse voltage
EMC	electrolytic, metal cased	plstc	plastic
EMT	electroyltic, metal tubular	PMC	paper, metal cased
ext	external	poly	polystyrene
f	farad	Prec	precision
F & I	focus and intensity	PT	paper tubular
FHS	flat head steel	PTM	paper or plastic, tubular, molded
Fil HS	fillister head steel	RHS	round head steel
g or G	giga, or 10^9	rms	root mean square
Ge	germanium	sec	second
GMV	guaranteed minimum value	Si	silicon
h	henry	S/N	serial number
hex	hexagonal	t or T	tera, or 10^{12}
HHS	hex head steel	TD	toroid
HSS	hex socket steel	THS	truss head steel
HV	high voltage	tub.	tubular
ID	inside diameter	v or V	volt
incd	incandescent	Var	variable
int	internal	w	watt
k or K	kilohms or kilo (10^3)	w/	with
kc	kilocycle	w/o	without
m	milli, or 10^{-3}	WW	wire-wound
mc	megacycle		

SPECIAL NOTES AND SYMBOLS

X000	Part first added at this serial number.
000X	Part removed after this serial number.
*000-000	Asterisk preceding Tektronix Part Number indicates manufactured by or for Tektronix, or reworked or checked components.
Use 000-000	Part number indicated is direct replacement.
	Internal screwdriver adjustment.
	Front-panel adjustment or connector.

Exploded View

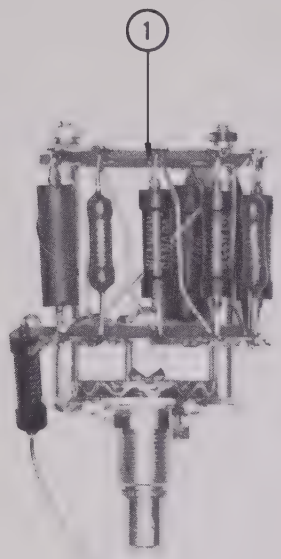


Exploded View

REF. NO.	PART NO.	SERIAL NO. EFF.	SERIAL NO. DISC.	QTY.	DESCRIPTION
1	211-565			20	SCREW, 6-32 x 1/4 in. truss HS, phillips slot
2	366-109			2	KNOB, PLUG-IN SECURING
3	366-153			1	KNOB, POWER AND SCALE ILLUM.
	210-413			1	NUT, hex., brass, 3/8-32 x 1/2 in.
	210-840			1	WASHER, steel
	210-013			1	LOCKWASHER, steel, internal 3/8 x 11/16 in.
4	352-014			1	HOLDER, fuse, with hardware
	200-237			1	COVER, insulation, fuse holder, clear
5	352-049			1	HOLDER, reflector shield
	337-540			1	SHIELD, reflector
6	354-181			1	RING, CRT shockmount, black neoprene
7	366-113			1	KNOB, INTENSITY
	210-583			1	NUT, hex, 5/16 brass, 1/4-32 in.
	210-940			1	WASHER, steel, 1/4 in.
8	210-571			4	NUT, graticule cover, 3/8 in. alum. 10-32 knurled
9	200-426			1	COVER, trim and graticule assembly
10	337-539			1	SHIELD, implosion, plexiglass
11	367-032			2	HANDLE, nickel plated
	213-090			2	SCREW, 10-32 x 1/2 in. hex.
12	366-113			1	KNOB, FOCUS
	210-583			1	NUT, hex, 5/16 brass, 1/4-32 in.
	210-940			1	WASHER, steel, 1/4 in.
13	366-153			1	KNOB, CALIBRATOR
	210-413			1	NUT, hex, brass, 3/8-32 x 1/2 in.
	210-840			1	WASHER, steel
	210-013			1	LOCKWASHER, steel, internal 3/8 x 11/16 in.
14	131-064			1	CONNECTOR, chassis mount. cal. out coax
					Mounting Hardware: (not included)
	406-244			1	BRACKET, nylon molded, coax insulator
	210-224			1	LUG, solder, #10, non-locking
	210-812			2	WASHER, fiber #10
	210-004			2	LOCKWASHER, steel, internal #4
	210-406			2	NUT, hex, brass, 4-40 x 3/16 in.
15	333-731			1	PANEL, front
16	387-696			1	PLATE, subpanel, front
17	136-031			1	SOCKET, light, red, assembly
18	210-011			2	LOCKWASHER, steel, internal 1/4 in.
19	358-010			2	BUSHING, alum. 3/8-32 x 9/16 in.
	210-013			2	LOCKWASHER, steel, internal 3/8 x 11/16 in.
	210-494			2	NUT, hex, alum. 3/8-32 x 1/2 x 11/16 in.
	210-012			2	LOCKWASHER, steel, pot, internal 3/8 x 1/2 in.
	210-207			2	LUG, solder, pot, plain, 3/8 in.
20	337-536			1	SHIELD, Focus and Intensity, left
21	337-535			1	SHIELD, Focus and Intensity, right
22	387-450			1	PLATE, left side cover
	387-449			1	PLATE, right side cover
					Mounting Hardware: (not included)
	211-504			8	SCREW, 6-32 x 1/4 in. BHS
	211-541			8	SCREW, 6-32 x 1/4 in. FHS, 100° CSK, phillips
23	387-716			1	PLATE, bulkhead
					Mounting Hardware: (not included)
	212-002			10	SCREW, 8-32 x 1/4 in. FHS, 100° CSK
	210-458			10	NUT, keps, steel, 8-32 x 11/32 in.
24	406-716			2	BRACKET, plug-in, alum.
					Mounting Hardware: (not included)
	212-004			2	SCREW, 8-32 x 5/16 in. BHS
	212-070			2	SCREW, 8-32 x 5/16 in. FHS, phillips
	210-458			4	NUT, keps, steel, 8-32 x 11/32 in.
25	387-447			1	PLATE, side left
26	352-015			2	HOLDER, nylon, for coil form
	213-045			2	SCREW, 4-40 x 5/16 in. Pan Head, phillips

REF. NO.	PART NO.	SERIAL NO. EFF.	SERIAL NO. DISC.	QTY.	DESCRIPTION
27	385-113			2	ROD, nylon, $5/16$ x $1\ 1/8$ in.
	211-507			2	SCREW, 6-32 x $5/16$ in BHS
28	Pg. 7-8				Chassis, rear
29	Pg. 7-10				CRT Shield
30	212-070			32	SCREW, 8-32 x $5/16$ in. FHS, phillips
	210-458			32	NUT, keps, steel, 8-32 x $11/32$ in.
31	385-013			2	ROD, nylon, $5/16$ x $3/4$ in.
	343-004			2	CLAMP, cable, $5/16$ in., plastic
	210-863			2	WASHER, steel, "D" Type for #10 screw
	211-507			4	SCREW, 6-32 x $5/16$ in. BHS
32	351-046			2	GUIDE, fan clips
					Mounting Hardware: (not included)
	211-538			2	SCREW, 6-32 x $5/16$ in. FHS, 100° CSK, phillips
	210-006			2	LOCKWASHER, steel, internal #6
	210-407			2	NUT, hex, 6-32 x $1/4$ in.
33	131-150			1	CONNECTOR, chassis mount, 3 wire motor base assembly
	213-041			2	SCREW, 5-32 x $3/16$ in. Pan H, phillips
34	119-013			1	BLOWER, fan, assembly
35	378-761			1	SCREEN, grille for fan
36	134-012			1	PLUG, plated, banana male, twin
37	136-139			1	SOCKET, banana jack assembly, with red nylon cap
	136-140			1	SOCKET, banana jack assembly, with charcoal nylon cap
	210-898			1	WASHER, insulating, red
	210-011			1	LOCKWASHER, steel, internal $1/4$ in.
	210-223			1	LUG, solder, $1/4$ in.
	210-465			3	NUT, hex, brass, $1/4$-32 x $3/8$ in.
38	387-695			1	PLATE, rear
					Mounting Hardware: (not included)
	212-004			4	SCREW, 8-32 x $5/16$ in. BHS
	210-458			4	NUT, keps, steel, 8-32 x $11/32$ in.
39	131-148			2	CONNECTOR, chassis mount, 24 contact amp.
					Mounting Hardware : (not included)
	211-014			2	SCREW, 4-40 x $1/2$ in. BHS
	166-029			2	TUBE, spacer, alum.
	210-004			2	LOCKWASHER, steel, internal #4
	210-406			2	NUT, hex, brass, 4-40 x $3/16$ in.
40	406-893			1	BRACKET, pot mounting
					Mounting Hardware: (not included)
	211-504			2	SCREW, 6-32 x $1/4$ in. BHS
41	387-446			1	PLATE, side right
42	351-047			2	GUIDE, rail track, alum.
					Mounting Hardware: (not included)
	211-541			2	SCREW, 6-32 x $1/4$ in. FHS, 100° CSK, phillips
	210-407			1	NUT, hex, brass, 6-32 x $1/4$ in.
43	Pg. 7-6				Chassis, front
44	214-052			1	FASTENER, right, with stop assembly
	214-053			1	FASTENER, left, with stop assembly
					Mounting Hardware: (not included)
	210-004			2	LOCKWASHER, steel, internal #4
	210-406			2	NUT, hex, brass, 4-40 x $3/16$ in.
45	387-452			2	PLATE, dust cover, top and bottom
					Mounting Hardware: (not included)
	211-565			10	SCREW, 6-32 x $1/4$ in. truss HS, phillips slot

Switches

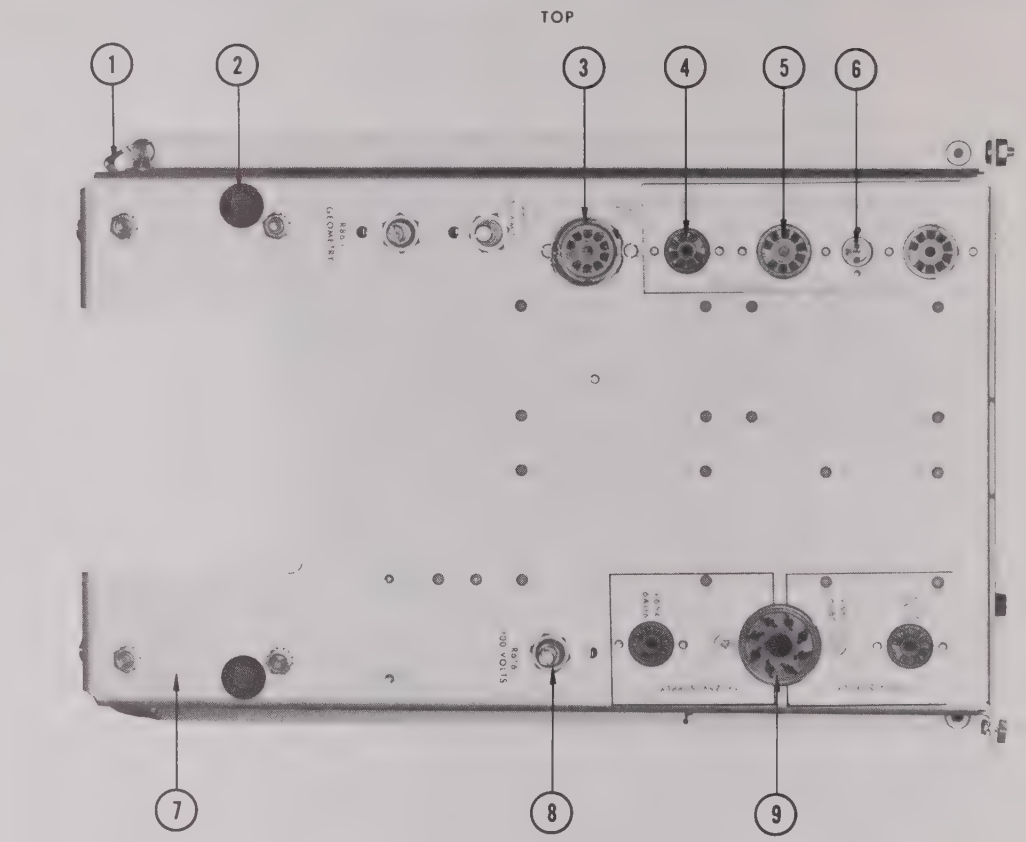


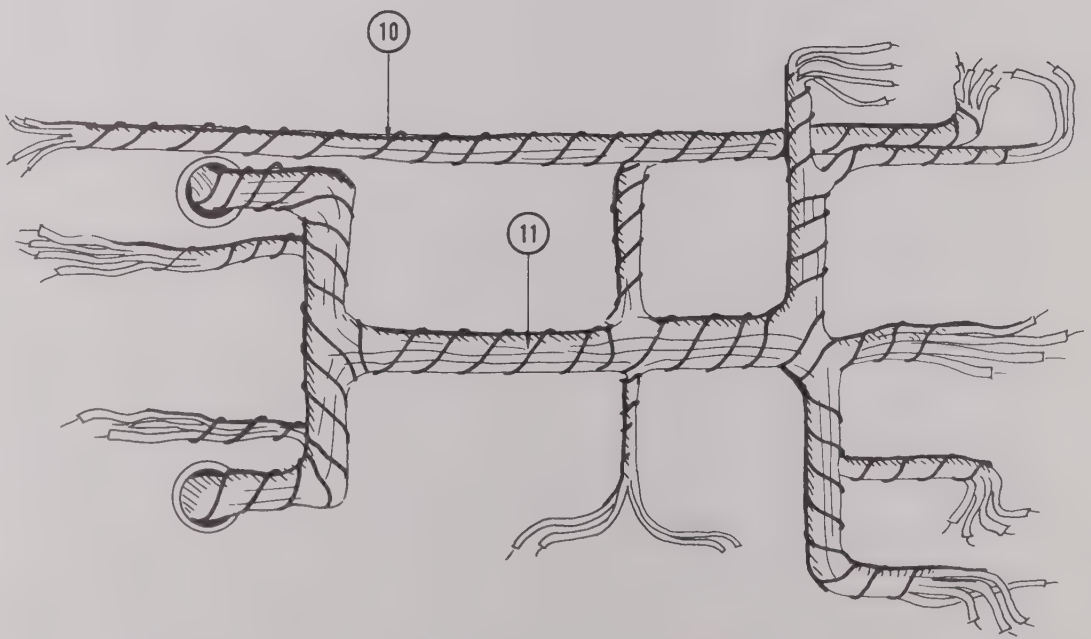
CALIBRATOR

SLIDE SPDT

REF. NO.	PART NO.	SERIAL NO. EFF.	SERIAL NO. DISC.	QTY.	DESCRIPTION
1	262-515			1	SWITCH, Calibrator, wired
	260-394				SWITCH, Calibrator, unwired
					Mounting Hardware: (not included)
	210-413			1	NUT, hex, brass $^{3}/_{8}$-32 x $^{1}/_{2}$ in.
	210-840			1	WASHER, steel
	210-013			1	LOCKWASHER, steel, internal $^{3}/_{8}$ x $^{11}/_{16}$ in.
2	260-449			1	SWITCH, raw, slide, SPDT
					Mounting Hardware: (not included)
	211-008			2	SCREW, 4-40 x $^{1}/_{4}$ in. BHS
	210-406			2	NUT, hex, brass, 4-40 x $^{3}/_{16}$ in.

Front Chassis & Cable Harness



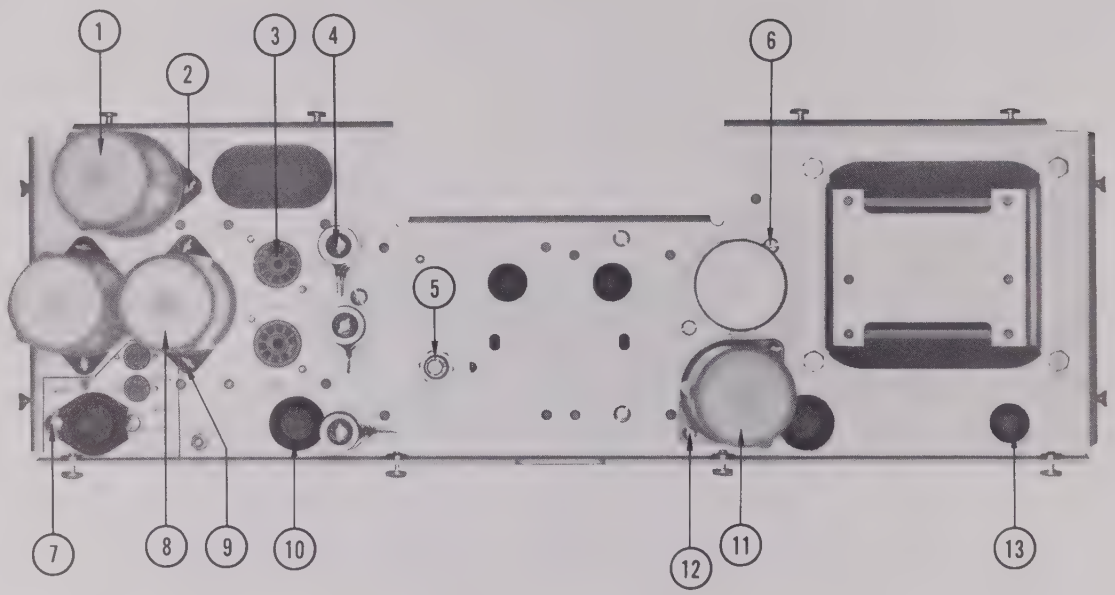


FRONT CHASSIS & CABLE HARNESSES

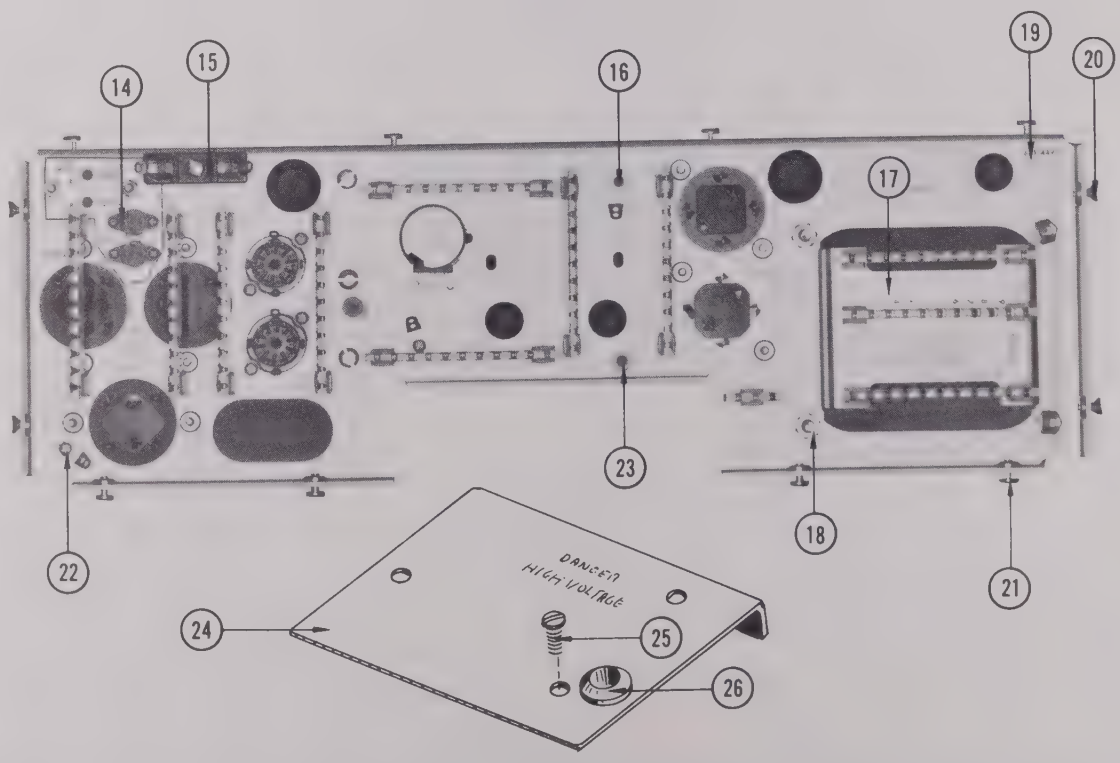
REF. NO.	PART NO.	SERIAL NO. EFF.	SERIAL NO. DISC.	QTY.	DESCRIPTION
1	344-095			2	CLIP, grounding
					Mounting Hardware: (not included)
	211-559			1	SCREW, steel, 6-32 x 3/8 in. FHS, 100° CSK
	210-803			1	WASHER, steel, 6L x 3/8 in.
	210-006			1	LOCKWASHER, steel, internal #6
	210-407			1	NUT, hex, brass, 6-32 x 1/4 in.
2	348-006			2	GROMMET, rubber, 3/4 in.
3	136-022			2	SOCKET, STM9S
					Mounting Hardware: (not included)
	211-033			2	SCREW, 4-40 x 5/16 in. Pan HS, with lockwasher
	210-004			2	LOCKWASHER, steel internal #4
	210-406			2	NUT, hex, brass, 4-40 x 3/16 in.
4	136-008			3	SOCKET, STM7G
					Mounting Hardware: (not included)
	213-044			2	SCREW, 5-32 x 3/16 in. Pan H, thread cutting
5	136-015			2	SOCKET, STM9G
					Mounting Hardware: (not included)
	213-044			2	SCREW, 5-32 x 3/16 in. Pan H, thread cutting
6	136-095			1	SOCKET, 4 pin, transistor
					Mounting Hardware: (not included)
	213-113			2	SCREW, 2-32 x 5/16 in. RHS, thread forming
7	441-448			1	CHASSIS, front
					Mounting Hardware: (not included)
	212-004			6	SCREW, 8-32 x 5/16 in. BHS
	212-070			2	SCREW, 8-32 x 5/16 in. FHS, phillips
	210-458			4	NUT, keps, steel, 8-32 x 11/32 in.
8					Pot Mounting Hardware:
	210-413			1	NUT, hex, brass, 3/8-32 x 1/2 in.
	210-840			1	WASHER, steel
9	136-013			1	SOCKET, STM8
					Mounting Hardware: (not included)
	211-538			2	SCREW, 6-32 x 5/16 in. FHS, 100° CSK, phillips
	210-006			1	LOCKWASHER, steel, internal #6
	210-203			1	LUG, solder, SE6, long.
	210-407			2	NUT, hex, brass, 6-32 x 1/4 in.
10	179-699			1	CABLE harness, amphenol
11	179-699			1	CABLE harness, chassis

Rear Chassis

TOP



BOTTOM

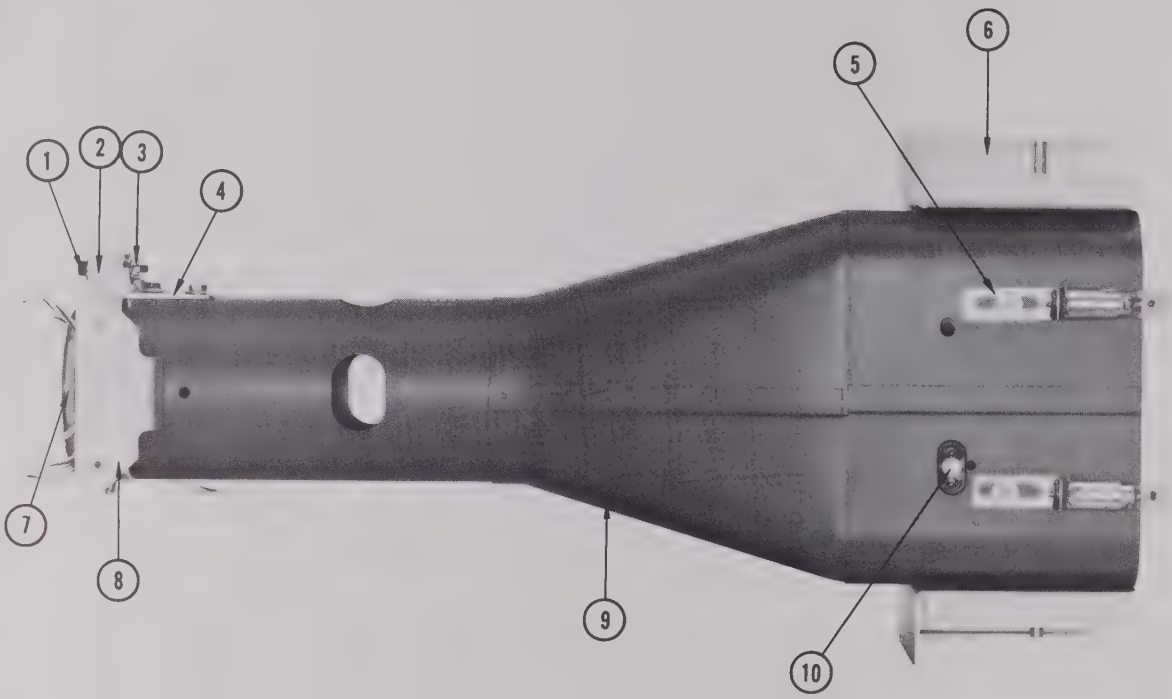


A

REAR CHASSIS

REF. NO.	PART NO.	SERIAL NO. EFF.	SERIAL NO. DISC.	QTY.	DESCRIPTION
1	200-258			1	COVER, capacitor, polyethylene
	386-254			1	PLATE, fiber, large, capacitor mounting
					Mounting Hardware: (not included)
2	211-543			2	SCREW, 6-32 x 5/16 in. RHS
3	136-015			2	SOCKET, STM9G
					Mounting Hardware: (not included)
	213-044			2	SCREW, thread cutting, 5-32 x 3/16 in. Pan H phillips
4					Resistor Mounting Hardware:
	212-037			3	SCREW, 8-32 x 1 3/4 in. Fil HS
	210-808			3	WASHER, brass, centering resistor
	210-462			3	NUT, hex, alum. 8-32 x 1/2 in.
	212-004			3	SCREW, 8-32 x 5/16 in. BHS
5					Pot Mounting Hardware:
	210-413			1	NUT, hex, brass, 3/8-32 x 1/2 in.
	210-840			1	WASHER, steel
6	386-255			1	PLATE, metal large, capacitor mounting
					Mounting Hardware: (not included)
	211-534			2	SCREW, 6-32 x 5/16 in. PHS, with lockwasher
7					Transistor Mounting Hardware:
	211-510			2	SCREW, 6-32 x 3/8 in. BHS
	210-006			1	LOCKWASHER, steel, internal #6
	210-407			2	NUT, hex, brass, 6-32 x 1/4 in.
8	200-293			2	COVER, capacitor, polyethylene
	386-254			3	PLATE, fiber, large, capacitor mounting
9	211-543			4	SCREW, (capacitor assembly) 6-32 x 5/16 in. RHS
10	348-006			2	GROMMET, rubber, 3/4 in.
11	200-259			1	COVER, capacitor, polyethylene
	432-044			1	BASE, capacitor mounting
	386-254			1	PLATE, fiber, large, capacitor mounting
					Mounting Hardware: (not included)
12	211-532			2	SCREW, 6-32 x 3/4 in. HS Fil
13	348-005			5	GROMMET, rubber, 1/2 in.
14	136-095			2	SOCKET, 4 pin, transistor
					Mounting Hardware: (not included)
	213-113			2	SCREW, 2-32 x 5/16 in. RHS, phillips, thread forming
15	352-031			1	HOLDER, fuse, single, 3AG
					Mounting Hardware: (not included)
	211-510			1	SCREW, 6-32 x 3/8 in. BHS
	210-006			1	LOCKWASHER, steel, internal #6
	210-407			1	NUT, hex, brass, 6-32 x 1/4 in.
16	166-099			2	TUBE, spacer, alum. 1/4 x 1-23/32 in.
					Mounting Hardware: (not included)
	211-507			1	SCREW, 6-32 x 5/16 in. BHS
	210-202			1	LUG, solder, SE6
17	406-617			1	BRACKET, transformer strip mounting
					Mounting Hardware: (not included)
18	210-564			4	NUT, 10-32 x 3/8 in.
	210-010			4	LOCKWASHER, steel, internal #10
19	441-449			1	CHASSIS, rear
					Mounting Hardware: (not included)
20	212-070			4	SCREW, 8-32 x 5/16 in. FHS
21	212-004			8	SCREW, 8-32 x 5/16 in. BHS
22	210-201			2	LUG, solder, SE4
	213-044			2	SCREW, thread cutting, 5-32 x 3/16 in. Pan H
23	385-060			2	ROD, nylon, 5/16 dia. x 1 3/4 in.
	211-507			2	SCREW, 6-32 x 5/16 in. BHS
24	337-534			1	SHIELD, H. V. Power
					Mounting Hardware: (not included)
25	211-507			3	SCREW, 6-32 x 5/16 in. BHS
26	348-005			1	GROMMET, rubber, 1/2 in.

CRT SHIELD

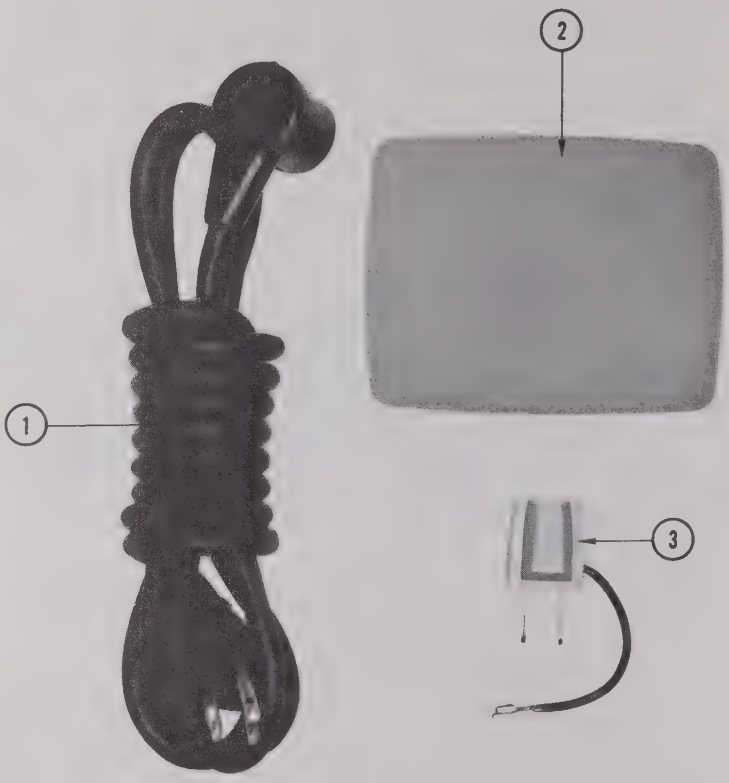


REF. NO.	PART NO	SERIAL NO. EFF.	SERIAL NO. DISC.	QTY.	DESCRIPTION
1	211-576			2	SCREW, 6-32 x 7/8 in. socket head cap, black finish
	210-949			2	WASHER, brass, 1/2 in.
2	354-147			1	RING, clamping, delrin, 1/2 x 2 1/4 in.
	211-560			1	SCREW, 6-32 x 1 in. RHS
	210-407			1	NUT, hex, brass, 6-32 x 1/4 in.
3	214-207			1	NUT, adj. securing
4	406-730			1	BRACKET, parallax adj. zinc plated
	211-534			4	Mounting Hardware: (not included) SCREW, 6-32 x 5/16 in. PHS, with lockwasher
	210-803			4	WASHER, steel, 6L x 3/8 in.
	210-006			4	LOCKWASHER, seel, internal #6
	210-407			4	NUT, hex, brass, 6-32 x 1/4 in.

CRT SHIELD

REF. NO.	PART NO.	SERIAL NO. EFF.	SERIAL NO. DISC.	QTY.	DESCRIPTION
5	136-035			2	SOCKET, graticule light, with ground lug
					Mounting Hardware: (not included)
	211-534			1	SCREW, 6-32 x 5/16 in. PHS, with lockwasher
	210-803			3	WASHER, steel, 6L x 3/8 in.
	210-006			1	LOCKWASHER, steel internal #6
	210-407			1	NUT, hex, brass, 6-32 x 1/4 in.
6	406-847			1	BRACKET, CRT Shield, left
					BRACKET, CRT Shield, right
	406-846			1	Mounting Hardware: (not included)
	212-004			2	SCREW, 8-32 x 5/16 in. BHS
	212-070			1	SCREW, 8-32 x 5/16 in. FHS, phillips
	210-458			3	NUT, keps, steel, 8-32 x 11/32 in.
	211-534			2	SCREW, 6-32 x 5/16 in. PHS, with lockwasher
	210-006			2	LOCKWASHER, steel, internal #6
	210-407			2	NUT, hex, brass, 6-32 x 1/4 in.
7	136-136			1	SOCKET, CRT assembly
					Consisting of:
	131-178			9	CONNECTOR, cable end
	136-117			1	SOCKET, CRT, 14 pin
	210-849			2	WASHER, fiber #4, shoulder
	210-850			2	WASHER, steel, #2, flat
	213-116			2	SCREW, thread cutting, #2 x 9/16 in., steel
	337-456			1	SHIELD, CRT socket
	387-393			1	PLATE, back, CRT socket
8	406-867			1	BRACKET, CRT mounting
					Mounting Hardware: (not included)
	211-504			1	SCREW, 6-32 x 1/4 in. BHS
	211-507			2	SCREW, 6-32 x 5/16 in. BHS
	210-803			2	WASHER, steel, 6L x 3/8 in.
9	337-530			1	SHIELD, CRT
10	352-044			1	HOLDER, form coil, CRT polypropylene, black
	211-011			1	SCREW, 4-40 x 5/16 in. BHS
	211-004			1	LOCKWASHER, steel, internal #4
	210-406			1	NUT, hex, brass, 4-40 x 3/16 in.

ACCESSORIES



REF. NO.	PART NO	SERIAL NO. EFF.	SERIAL NO. DISC.	QTY.	DESCRIPTION
1	161-013			1	CORD, power, 18 gauge, 8 ft.
2	378-534			1	FILTER, light, green plexiglas
3	103-013			1	ADAPTER, power cord, 3 wire to 2 wire

ELECTRICAL PARTS LIST

Values are fixed unless marked Variable.

Ckt. No.	Tektronix Part No.	Description	S/N Range
		Bulbs	
B601	150-001	Incandescent, G.E. #47, Graticule Light	
B602	150-001	Incandescent, G.E. #47, Graticule Light	
B603	150-004	Incandescent, G.E. #328, Pilot Light	
B856	150-025	Neon, NE-2E	
B857	150-025	Neon, NE-2E	
		Capacitors	

Tolerance ±20% unless otherwise indicated.
Tolerance of all electrolytic capacitors are as follows (with exceptions):

3 V — 50 V = —10%, +250%
51 V — 350 V = —10%, +100%
351 V — 450 V = —10%, +50%

C611	285-510	.01 μf	MT		400 v
C616	285-510	.01 μf	MT		400 v
C640A,B	*290-060	160 μf x 10 μf	EMC		350 v
C642A,B	*290-061	160 μf x 10 μf	EMC		350 v
C644	*290-133	2 x 125 μf	EMC		350 v
C650	285-510	.01 μf	MT		400 v
C667	290-002	8 μf	EMT		450 v
C670	285-510	.01 μf	MT		400 v
C720A	*290-193	2000 μf	EMC		30 v
C720B	*290-193	2000 μf	EMC		30 v
C732	Use 290-201	100 μf	EMT		15 v
C737	283-026	.2 μf	Disc Type		25 v
C757	290-015	100 μf	EMT		25 v
C760	281-027	.7-3 pf	Tub.	Var.	
C761	281-027	.7-3 pf	Tub.	Var.	
C801	283-006	.02 μf	Disc Type		600 v
C803	283-000	.001 μf	Disc Type		500 v
C807	285-502	.001 μf	MT		1000 v
C822	283-071	.0068 μf	Disc Type		5000 v
C830	283-036	.0025 μf	Disc Type		6000 v
C832	283-036	.0025 μf	Disc Type		6000 v
C837	283-036	.0025 μf	Disc Type		6000 v
C841	285-519	.047 μf	MT		400 v
C842	283-071	.0068 μf	Disc Type		5000 v
C853	283-036	.0025 μf	Disc Type		6000 v
C876	290-025	6.25 μf	EMT		300 v
C878	281-523	100 pf	Cer.		350 v
C884	281-524	150 pf	Cer.		500 v

Diodes

Ckt. No.	Tektronix Part No.	Description	S/N Range
D640A,B,C,D	152-047	Silicon 1N2862 (or equal)	
D642A,B,C,D	152-047	Silicon 1N2862 (or equal)	
D644A,B,C,D	152-047	Silicon 1N2862 (or equal)	
D720	152-035	Silicon 1N1563A	
D721	152-035	Silicon 1N1563A	
D838	152-047	Silicon 1N2862 (or equal)	
D839	152-047	Silicon 1N2862 (or equal)	

Fuses

F601	159-005	3 Amp	3AG	Slo-Blo	117 v oper.	50 & 60 cycle	
F601	159-041	1.25 AMP	3AG	Slo-Blo	234 v oper.	50 & 60 cycle	
F720	159-023	2 Amp	3AG	Slo-Blo			

Inductors

L860	Use *108-285	Beam Rotator

Resistors

Resistors are fixed, composition, ±10% unless otherwise indicated.

R601†	311-340	50 Ω		Var.		SCALE ILLUM.
R602	308-142	30 Ω	3 w		WW	5%
R603	304-330	33 Ω	1 w			
R609	302-106	10 meg	½ w			
R610	302-104	100 k	½ w			
R611	302-102	1 k	½ w			
R612	302-272	2.7 k	½ w			
R616	311-015	10 k		Var.	WW	—100 VOLTS
R617	308-186	80 k	½ w		WW	1%
R618	308-226	10 k	½ w		WW	1%
R619	302-224	220 k	½ w			
R624	302-473	47 k	½ w			
R625	302-222	2.2 k	½ w			
R626	302-184	180 k	½ w			
R627	302-102	1 k	½ w			
R628	308-176	4 k	20 w		WW	5%
R632	302-102	1 k	½ w			
R633	302-473	47 k	½ w			
R635	301-302	3 k	½ w			5%
R640	304-100	10 Ω	1 w			

† Concentric with SW601. Furnished as a unit.

Resistors *(Cont'd)*

Ckt. No.	Tektronix Part No.		Description				S/N Range
R642	304-100	10 Ω	1 w				
R644	304-100	10 Ω	1 w				
R650	309-101	330 k	½ w		Prec.	1%	
R651	309-162	250 k	½ w		Prec.	1%	
R652	302-102	1 k	½ w				
R653	302-225	2.2 meg	½ w				
R654	302-474	470 k	½ w				
R655	302-685	6.8 meg	½ w				
R656	311-068	500 k	.2 w	Var.		+125 VOLTS	
R657	302-684	680 k	½ w				
R658	302-273	27 k	½ w				
R659	302-333	33 k	½ w				
R663	302-102	1 k	½ w				
R664	302-102	1 k	½ w				
R666	308-176	4 k	20 w		WW	5%	
R667	308-176	4 k	20 w		WW	5%	
R670	309-156	1.024 meg	½ w		Prec.	1%	
R671	309-053	333 k	½ w		Prec.	1%	
R672	302-102	1 k	½ w				
R673	302-105	1 meg	½ w				
R675	302-825	8.2 meg	½ w				
R676	311-068	500 k	.2 w	Var.		+300 VOLTS	
R677	304-224	220 k	1 w				
R678	302-394	390 k	½ w				
R679	302-333	33 k	½ w				
R729	302-823	82 k	½ w				X5160-up
R730	311-068	500 k	.2 w	Var.		−12.2 VOLTS	
R731	309-104	2.05 k	½ w		Prec.	1%	
R732	310-115	15 k	1 w		Prec.	1%	
R733	302-564	560 k	½ w				5001-5159
R733	301-394	390 k	½ w			5%	5160-up
R734	302-334	330 k	½ w				
R735	302-272	2.7 k	½ w				
R737	302-151	150 Ω	½ w				
R744	308-231	220 Ω	3 w		WW	5%	
R754	302-471	470 Ω	½ w				
R759	302-104	100 k	½ w				
R770	302-564	560 k	½ w				
R781	316-470	47 Ω	¼ w				
R782	316-470	47 Ω	¼ w				
R783	316-470	47 Ω	¼ w				
R784	316-470	47 Ω	¼ w				
R801	306-681	680 Ω	2 w				
R802	302-562	5.6 k	½ w				
R803	306-273	27 k	2 w				
R806	302-104	100 k	½ w				
R807	302-472	4.7 k	½ w				

Resistors *(Cont'd)*

Ckt. No.	Tektronix Part No.	Description					S/N Range
R813	302-101	100 Ω	½ w				
R815	302-474	470 k	½ w				
R816	302-102	1 k	½ w				
R831	302-104	100 k	½ w				
R832	302-106	10 meg	½ w				
R833	311-349	2 meg		Var.		INTENSITY	
R834	302-105	1 meg	½ w				
R835	Use *050-115	Replacement Kit					5001-5609
R835†	(3) 306-565	5.6 meg	2 w				5610-up
	(2) 306-685	6.8 meg	2 w				
R836	302-223	22 k	½ w				
R837	302-471	470 Ω	½ w				
R838	301-242	2.4 k	½ w			5%	
R839	302-104	100 k	½ w				
R840	301-125	1.2 meg	½ w			5%	
R841	311-042	2 meg		Var.		HIGH VOLTAGE	
R842	Use *050-147	Replacement Kit					5001-5609
R842††	(3) 306-395	3.9 meg	2 w				5610-up
R844	311-254	5 meg	.2 w	Var.		FOCUS	
R846	304-225	2.2 meg	1 w				
R849	302-223	22 k	½ w				
R851	302-104	100 k	½ w				
R852	302-273	27 k	½ w				
R853	302-471	470 Ω	½ w				
R854	302-105	1 meg	½ w				
R860	311-007	2 x 1 k		Var.		ALIGNMENT	
R861	302-680	68 Ω	½ w				
R862	302-823	82 k	½ w				
R863	302-823	82 k	½ w				
R864	311-206	250 k		Var.		ASTIGMATISM	
R865	311-026	100 k		Var.		GEOMETRY	
R870	301-393	39 k	½ w			5%	
R871	311-315	20 k		Var.		CAL. AMPL.	
R872	301-154	150 k	½ w			5%	
R873	302-103	10 k	½ w				
R876	301-153	15 k	½ w			5%	
R877	301-183	18 k	½ w			5%	
R878	301-564	560 k	½ w			5%	
R879	Use 301-114	110 k	½ w			5%	
R883	305-223	22 k	2 w			5%	
R885	310-066	18 k	1 w		Prec.	1%	
R886	309-030	1.8 k	½ w		Prec.	1%	
R887	309-072	180 Ω	½ w		Prec.	1%	
R888	309-064	20 Ω	½ w		Prec.	1%	
R890	309-030	1.8 k	½ w		Prec.	1%	
R891	309-072	180 Ω	½ w		Prec.	1%	
R892	309-064	20 Ω	½ w		Prec.	1%	
R898	309-178	250 Ω	½ w		Prec.	1%	
R899	*308-090	¼ Ω	1 w		WW	1%	

† S/N 5610-up *050-115 may be used
†† S/N 5610-up *050-147 may be used

©

Switches

Ckt. No.	Tektronix Part No. Unwired	Wired	Description		S/N Range
SW601†	311-340			POWER ON-OFF	
SW854	260-447		Slide	CRT CATHODE SELECTOR	
SW870	260-394	*262-515	Rotary	CALIBRATOR	

† Concentric with R601. Furnished as a unit.

Thermal Cutouts

TK601	260-246	Thermal Cutout 123°

Transformers

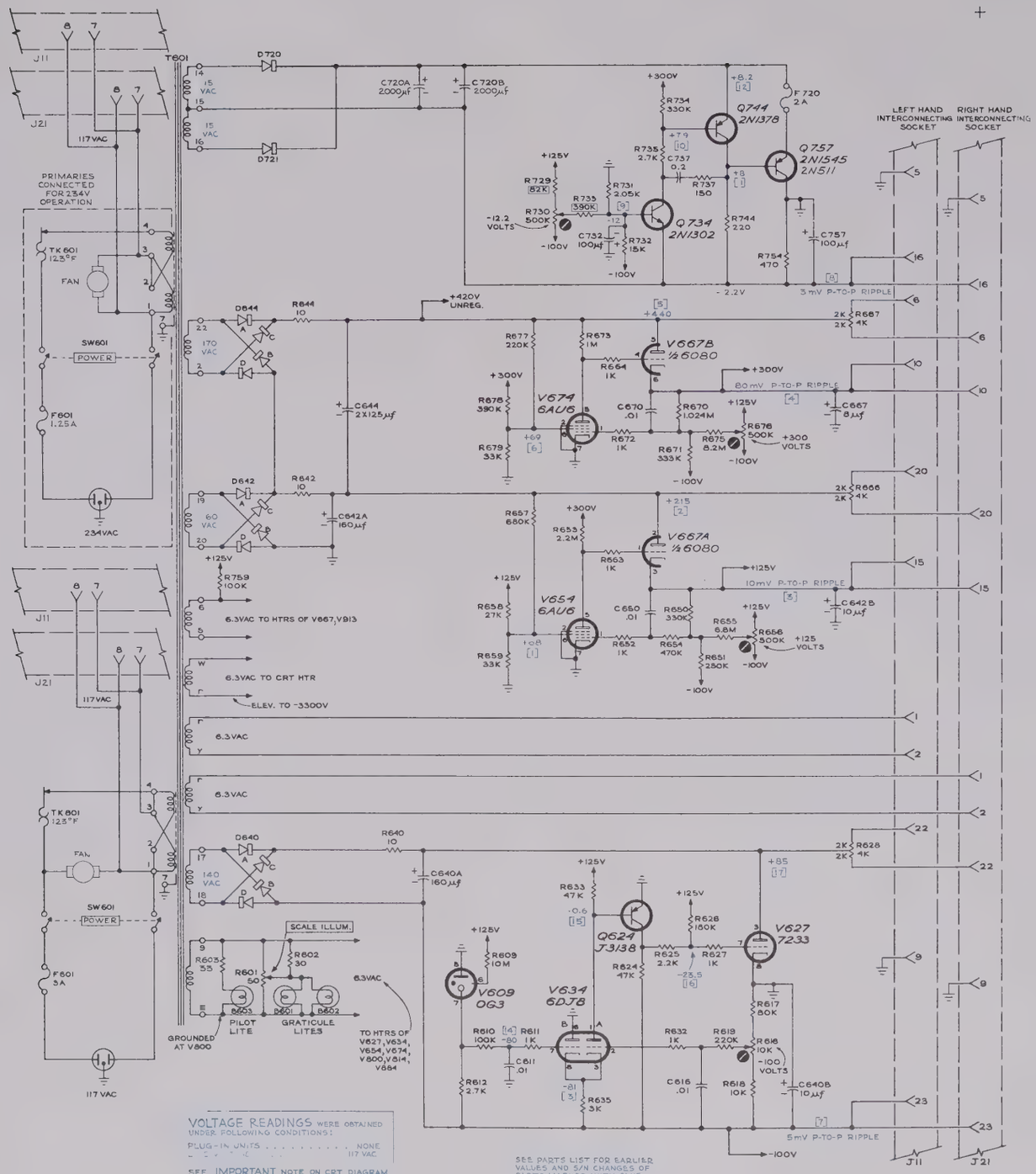
T601	*120-280	L.V. Power
T801	*120-297	H.V. Power

Transistors

Q624	151-087	J3138
Q734	151-040	2N1302
Q744	151-042	2N1378
Q757	151-046	2N1529

Electron Tubes

V609	154-291	0G3
V627	154-307	7233
V634	154-187	6DJ8
V654	154-022	6AU6
V667	154-056	6080
V674	154-022	6AU6
V800	154-167	6CZ5
V814	154-046	12BH7
V822	154-051	5642
V832	154-051	5642
V859	*154-400	T5610-31-1 CRT Standard Phosphor
V884	154-278	6BL8



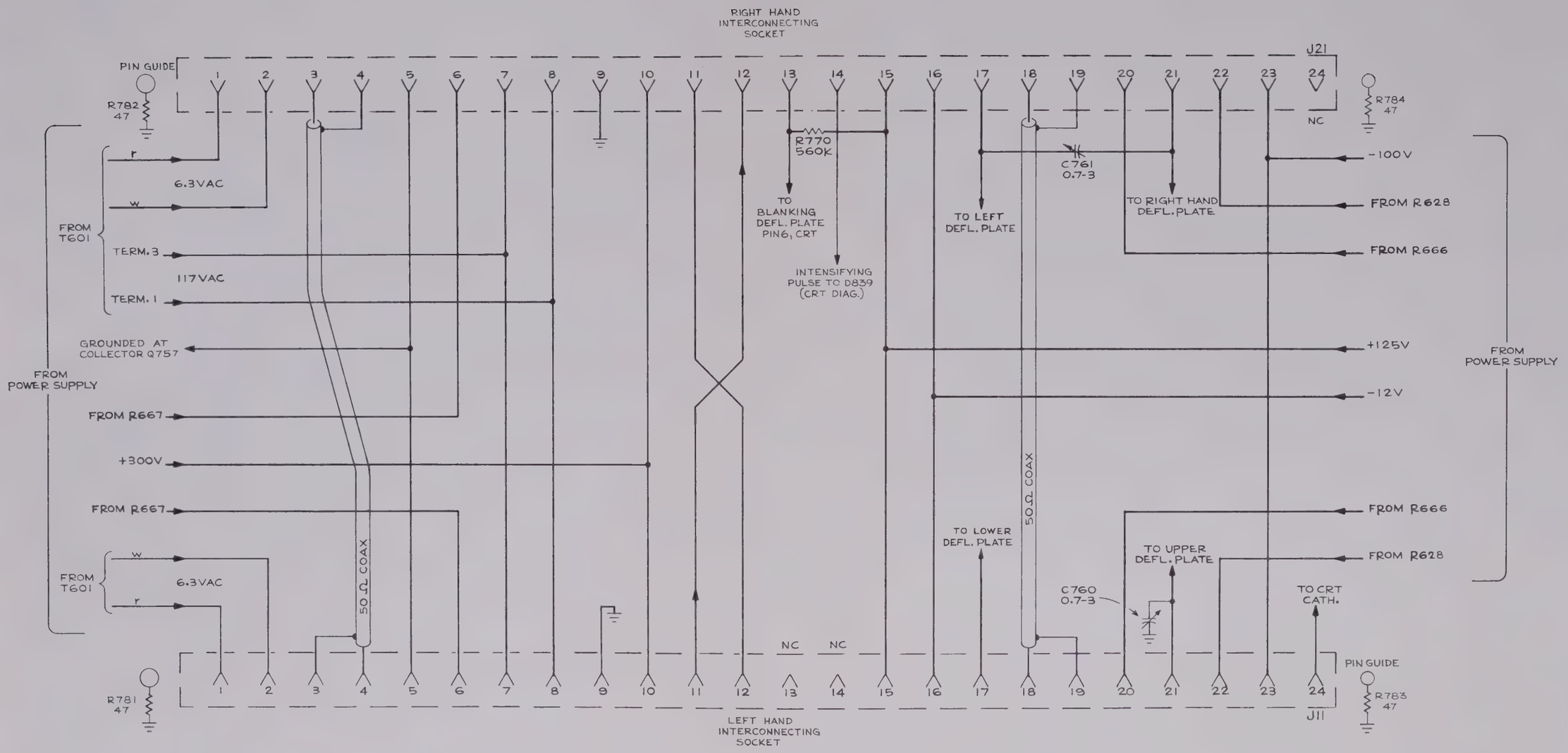
TYPE RM 561A OSCILLOSCOPE

A

CMD 863

POWER SUPPLY

CIRCUIT NUMBERS 600 THRU 769



863
TR

TYPE RM561A OSCILLOSCOPE

A

INTERCONNECTING SOCKETS

OSCILLATOR

+420V UNREG.

R801 680

C801 .02

T801

HV RECTIFIERS

+300V

R802 5.6K

R803 27K

V800 6CZ5

C807 .001

R807 4.7K

C803 .001

R806 100K

C822 .0068

-3300 [24]

V822 5642

V832 5642

C830 .0025

C832 .0025

R831 100K

-3450 [23]

R836 22K

[22] +0.54

+125V

R839 100K

D839

INTENSIFYING PULSE 14 J21

R838 2.4K

D838

R837 470

R835 30M

C837 .0025

R832 10M

R833 2M

R834 1M

INTENSITY

L860

V859

R860 2X1K

ALIGNMENT

R861 68

-12.2V

ERROR SIGNAL AMPLIFIERS

+83 [25]

+300V

V814A ½12BH7

R815 470K

-2.5 [26]

R813 100

V814B ½12BH7

R816 1K

-100V

C841 .047

+300V

R840 1.2M

HIGH VOLTAGE

R841 2M

R842 12M

R849 22K

FOCUS

R844 5M

C842 .0068

R846 2.2M

-3300V

1 DAG

ISOLATION SHIELD

+300V

R862 82K

R865 100K

GEOMETRY

R863 82K

+125V

+300V

ASTIGMATISM

R864 250K

+125V

BLANKING PULSE 13 J21

R770

+125V

SEE INTERCONNECTING SOCKETS DIAG.

B856 NE-2

B857 NE-2

ELEV. TO -3300V

6.3V AC

FROM T601 (POWER SUPPLY DIAGRAM)

R851 100K

HV TEST POINT

-3300 [21]

R852 27K

C853 .0025

R853 470

-3300 [20]

R854 1M

EXT. CRT. CATHODE J857

GND. J858

SW 854 CRT. CATHODE SELECTOR

J11 CHOPPED BLANKING 24

REAR PANEL

IMPORTANT:

ALL CIRCUIT VOLTAGES WERE OBTAINED WITH A 20,000Ω/V VOM. ALL READINGS ARE IN VOLTS.

VOLTAGE AMPLITUDE MEASUREMENTS, AS SHOWN, ARE NOT ABSOLUTE. THEY MAY VARY BETWEEN INSTRUMENTS AS WELL AS WITHIN THE INSTRUMENT ITSELF DUE TO NORMAL MANUFACTURING TOLERANCES, AND TRANSISTOR AND VACUUM TUBE CHARACTERISTICS.

VOLTAGE READINGS WERE OBTAINED UNDER FOLLOWING CONDITIONS:

PLUG-IN UNITS..... NONE
INTENSITY .....CCW

SEE PARTS LIST FOR EARLIER VALUES AND S/N CHANGES OF PARTS MARKED WITH BLUE OUTLINE

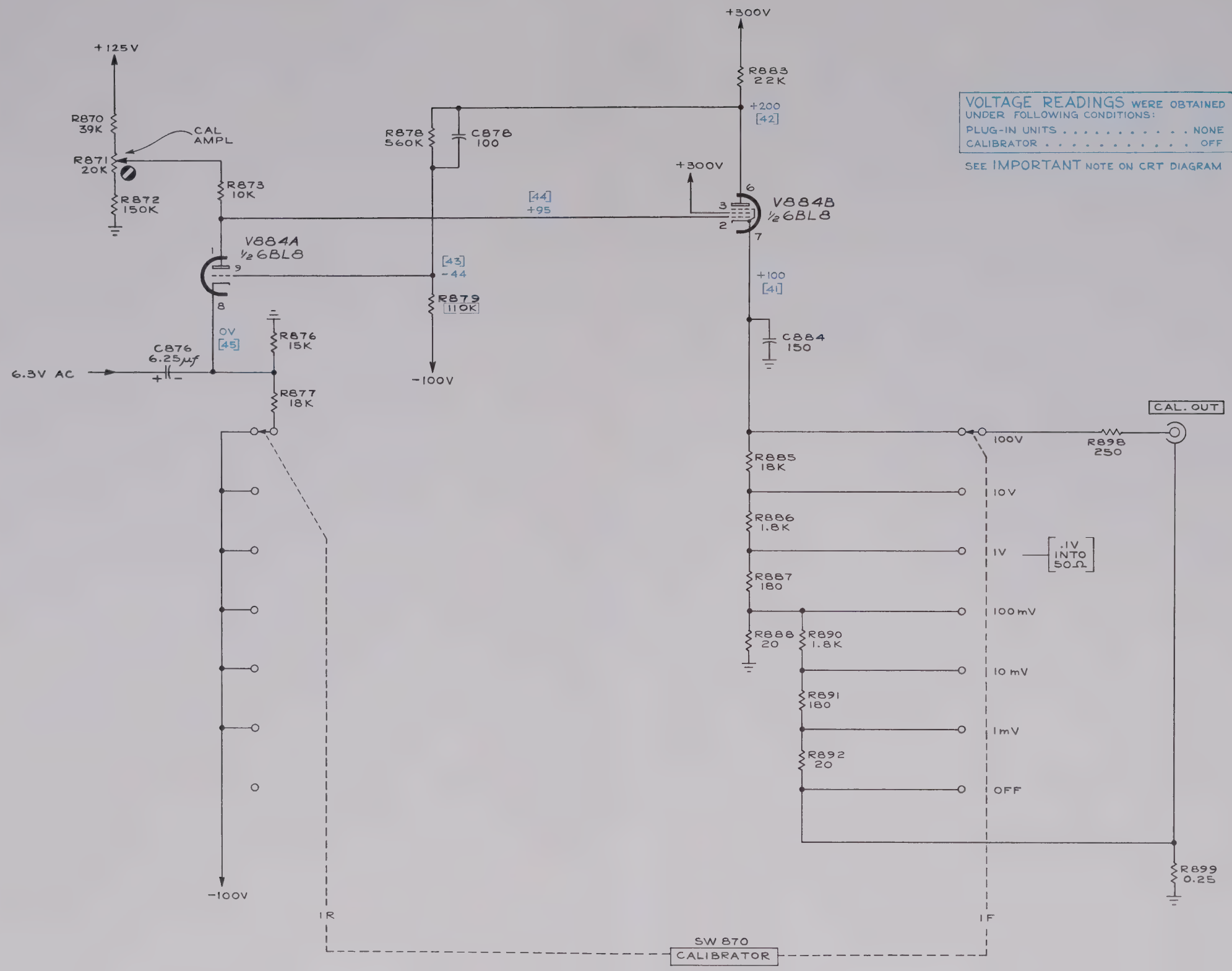
TYPE RM561A OSCILLOSCOPE

B

CMD 863

CRT CIRCUIT

CIRCUIT NUMBERS 800 THRU 869



VOLTAGE READINGS WERE OBTAINED UNDER FOLLOWING CONDITIONS:

PLUG-IN UNITS . . . . . NONE

CALIBRATOR . . . . . OFF

SEE IMPORTANT NOTE ON CRT DIAGRAM

SEE PARTS LIST FOR EARLIER VALUES AND S/N CHANGES OF PARTS MARKED WITH BLUE OUTLINE

PLM 1063

CALIBRATOR

MANUAL CHANGE INFORMATION

At Tektronix, we continually strive to keep up with latest electronic developments by adding circuit and component improvements to our instruments as soon as they are developed and tested.

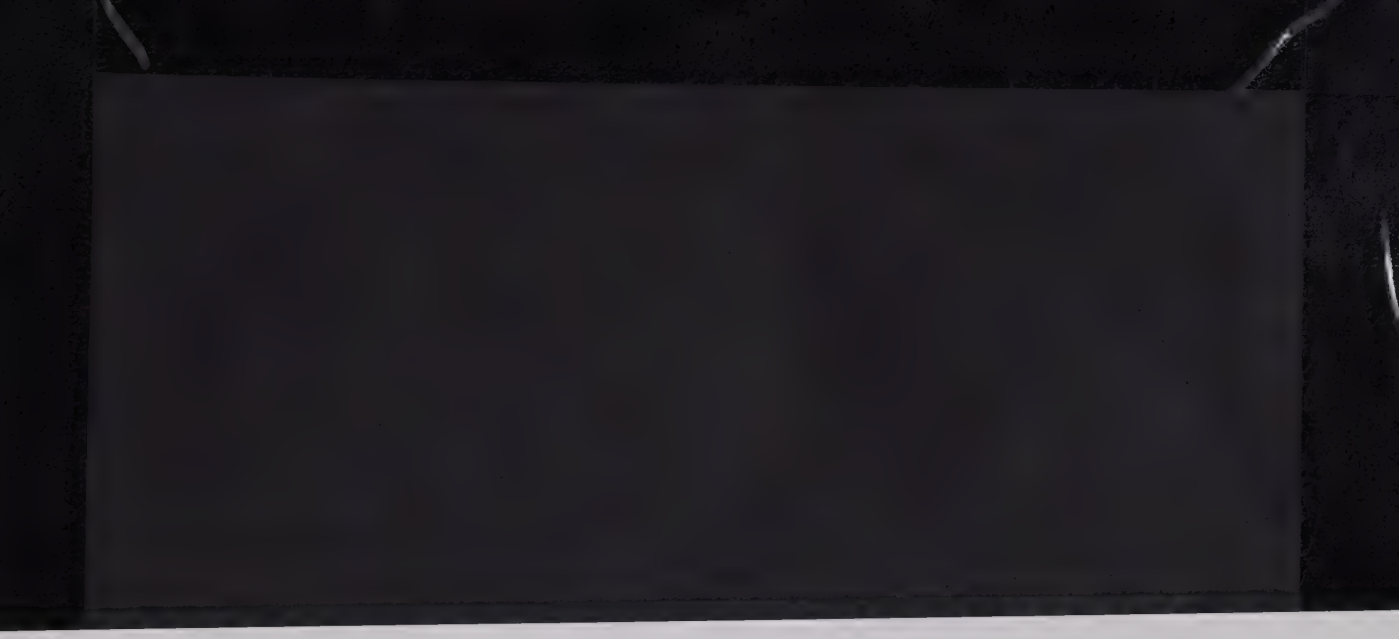
Sometimes, due to printing and shipping requirements, we can't get these changes immediately into printed manuals. Hence, your manual may contain new change information on following pages. If it does not, your manual is correct as printed.

TYPE 561A - TENT. S/N 11950
TYPE RM561A - TENT. S/N 6600

PARTS LIST CORRECTION

CHANGE TO:

C751	290-231	100 μf	EMT	25v



HOW TO USE THIS INSERT

This insert is written to supplement information given in the Instruction Manual furnished with this modified instrument. Included in this insert is a description of the modification, parts list changes, schematic changes and any changes in operation or calibration necessary as a result of this modification. In cases where information in the manual and the insert differ, the information given in this insert will supersede that given in the manual.

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TYPE RM561A

MOD 505B

SN. 6607

TYPE RM561A
MOD 505B

The instrument for which this manual was prepared has been modified for use as a system with the associated plug-in units. The following changes have been made.

Only the controls and connectors essential to the operation of this system remain on the front panel. The CALIBRATOR switch and CAL. OUT connector have been removed. The FUSE has been moved to the rear panel. The TRACE ALIGNMENT control has been relocated internally.

A separate POWER ON switch and SCALE ILLUM. control are provided.

The pilot light and the ASTIGMATISM control have been relocated on the front panel.

The following inputs are provided on the rear panel: VERTICAL INPUTS A, B, C, D and EXT. TRIGGER input. The rear panel connectors are Type BSM subminiature coaxial bayonet connectors.

The entire Calibrator circuit has been removed from the instrument.

Control-grid unblanking is used in this system. The circuitry for deflection-plate unblanking remains although it is disabled when the Time Base plug-in is installed.

Tektronix identification has been removed from the front panel.

The front-panel handles have been removed.

Special knobs are used on the front-panel controls.

OPERATION

Basic operation of this modified instrument is the same as that described in the Instruction Manual furnished with this instrument. The changes listed above must be taken into account in any procedures described therein.

NOTE

Due to the extensive modifications made in this instrument, this indicator unit may not operate properly with unmodified plug-in units. Use only with similarly modified plug-in units.

CALIBRATION

The complete calibration procedure for this modified instrument is given below. Although this procedure differs from the standard procedure given in the Instruction Manual, some of the steps from the manual will be used. Since this instrument is designed for use as a system, a Type 3A74, MOD 505B FOUR-TRACE AMPLIFIER and a Type 2B67, MOD 505B TIME BASE plug-in unit should be used for this calibration procedure.

Equipment Required

Delete item (5) from the equipment list given in the Instruction Manual. The remainder of the equipment is used in this procedure.

Procedure

Perform the following calibration steps as given in the Instruction Manual.

Preliminary

Power Supply Adjustment

Power Supply Ripple Check

Trace Alignment

Geometry

Delete the following calibration steps given in the manual.

Calibrator Adjustment

Effective Deflection-Circuit Capacitance

Vertical Capacitance

Horizontal Capacitance

SCHEMATIC DIAGRAMS

Corrections and additions to the schematic diagrams are given following the Parts List in this insert. These changes are to be used in conjunction with the schematics given in the Instruction Manual.

PARTS LIST

Parts changed in this modified instrument are listed below. These changes are also shown schematically in this insert. When ordering replacement parts, specify instrument type, serial number and MOD number. For mechanical parts include the part number (or drawing number) and a description of the part. Electrical parts not used in the standard instrument but only used in this modified instrument are designated with an 'S' suffix (for example, C400-S) and should be ordered using this complete circuit number.

BULBS

B603	Change to	150-018	Incandescent #12
B855-S	Add	150-002	NE-2

CAPACITORS

C837	Change to	283-082	.01μf cer 4kv
C838-S	Add	283-082	.01μf cer 4kv
C876	Delete		
C878	Delete		
C884	Delete		

DIODES

D838	Delete
D839	Delete

RESISTORS

R601	Change to	311-055	50Ω	var	SCALE ILLUM	
R836	Change to	302-102	1k	1/2w	10%	comp
R838	Change to	302-104	100k	1/2w	10%	comp
R839	Delete					
R864	Change to	311-068	500k	var	ASTIGMATISM	
R870	Delete					
R871	Delete					
R872	Delete					
R873	Delete					
R876	Delete					
R877	Delete					
R878	Delete					
R879	Delete					
R883	Delete					
R885	Delete					
R886	Delete					
R887	Delete					
R888	Delete					
R890	Delete					
R891	Delete					
R892	Delete					
R898	Delete					
R899	Delete					

SWITCHES

SW601	Change to	260-276	DPST toggle	POWER ON
SW870	Delete			

TUBES

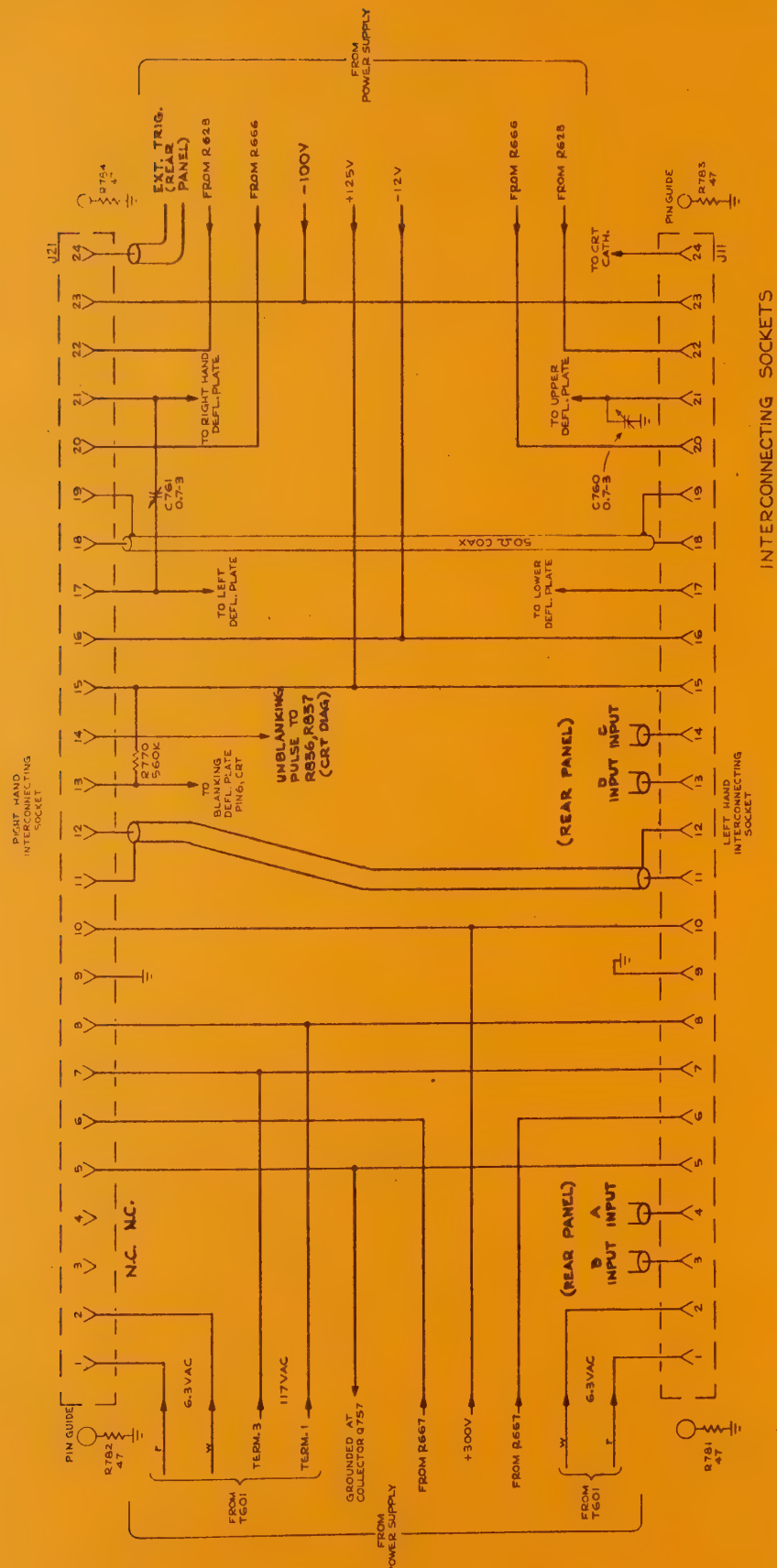
V859	Change to	154-398	T5610-7-1

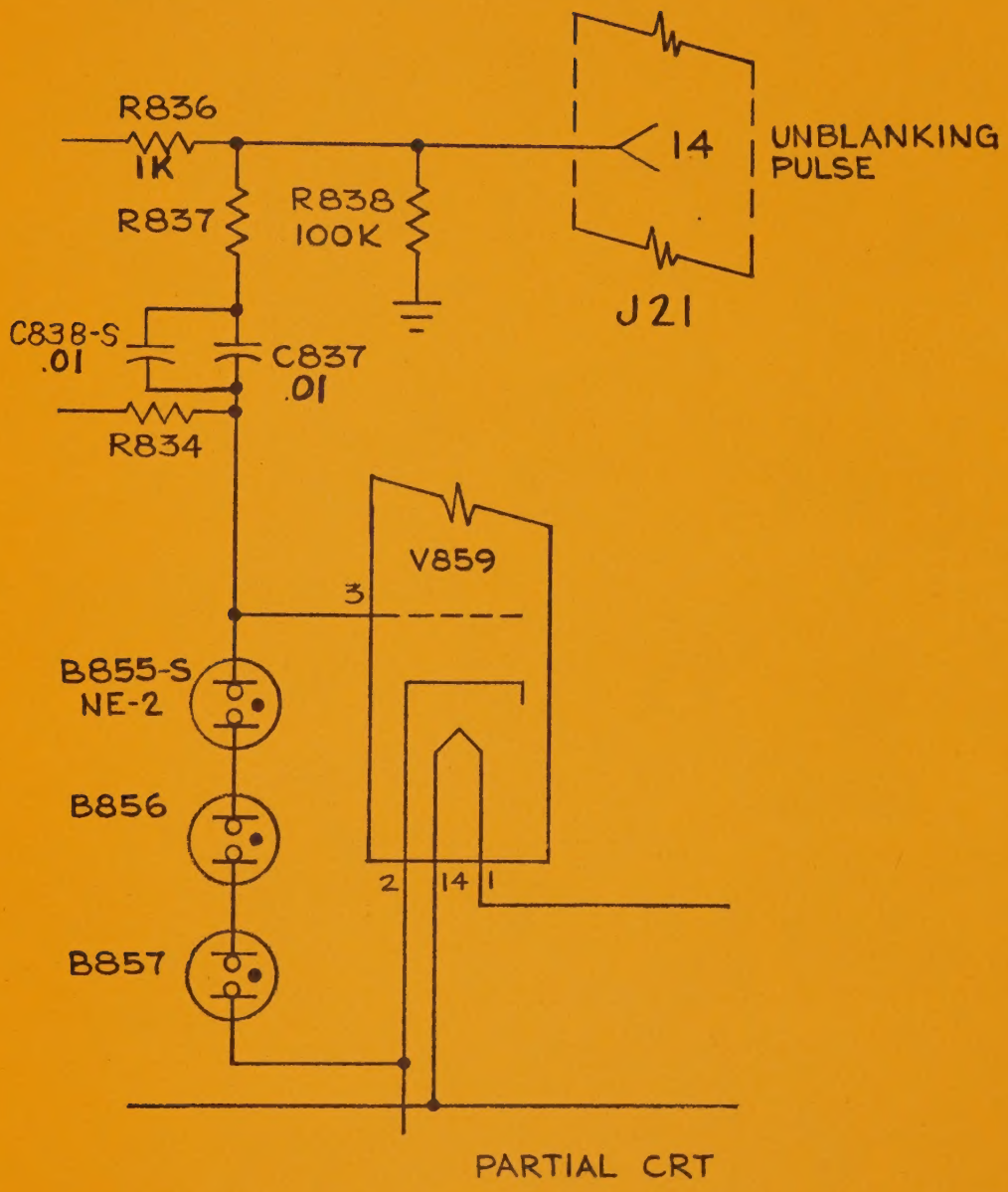
MECHANICAL

BUSHING, 1/4"	Add	1	358-054
BUSHING, Panel	Delete	1	
CABLE, RG174/U Coax	Add		175-068

CONNECTOR, BSM, Automatic Metal Products #0724m25	Add	5	Special
CONNECTOR, BNC	Delete	1	
HANDLE	Delete	2	
KNOB, Small Gray*	Add	2	Special
KNOB, Medium Gray*	Add	1	Special
KNOB, Small Black	Delete	2	
KNOB, Small Gray	Delete	2	
PANEL, Front	Change to		Film #1823
PLATE, Right Side	Change to		Dwg B-S69
PLATE, Left Side	Change to		Dwg B-S70
PLATE, Right Side Cover	Change to		Dwg C-S105
PLATE, Left Side Cover	Change to		Dwg C-S104
PLATE, Rear Frame	Change to		Dwg C-S103
PLATE, Front Subpanel	Change to		Dwg C-S102
SOCKET, Pilot Light	Change to		136-047
TAG, Tektronix Identification	Add	1	Film #1802

*Supplied by Customer


INTERCONNECTING SOCKETS
RIGHT HAND INTERCONNECTING SOCKET
LEFT HAND INTERCONNECTING SOCKET
J21
J11
FROM POWER SUPPLY
EXT. TRIG. (REAR PANEL)
FROM R623
FROM R666
-100V
+125V
-12V
TO RIGHT HAND DEFL. PLATE
TO LEFT DEFL. PLATE
TO UPPER DEFL. PLATE
TO LOWER DEFL. PLATE
TO CRT CATH.
PIN GUIDE
R754 47
R783 47
C761 0.7-3
C760 0.7-3
50Ω COAX
R770 560K
TO BLANKING DEFL. PLATE PIN 6, CRT
UNBLANKING PULSE TO R836, R837 (CRT DIAG.)
(REAR PANEL) D INPUT C INPUT
(REAR PANEL) B INPUT A INPUT
N.C. N.C.
R782 47
R781 47
6.3VAC
117VAC
TERM. 3
TERM. 1
FROM T601
GROUNDED AT COLLECTOR Q757
FROM R667
+300V
FROM R661


R836
1K
R837
R838
100K
14
UNBLANKING
PULSE
J21
C838-S
.01
C837
.01
R834
V859
3
B855-S
NE-2
B856
B857
2
14
1
PARTIAL CRT